A Scranton Gillette Publication

APRIL 1960

WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL

UNIVERSITY MICROFILMS
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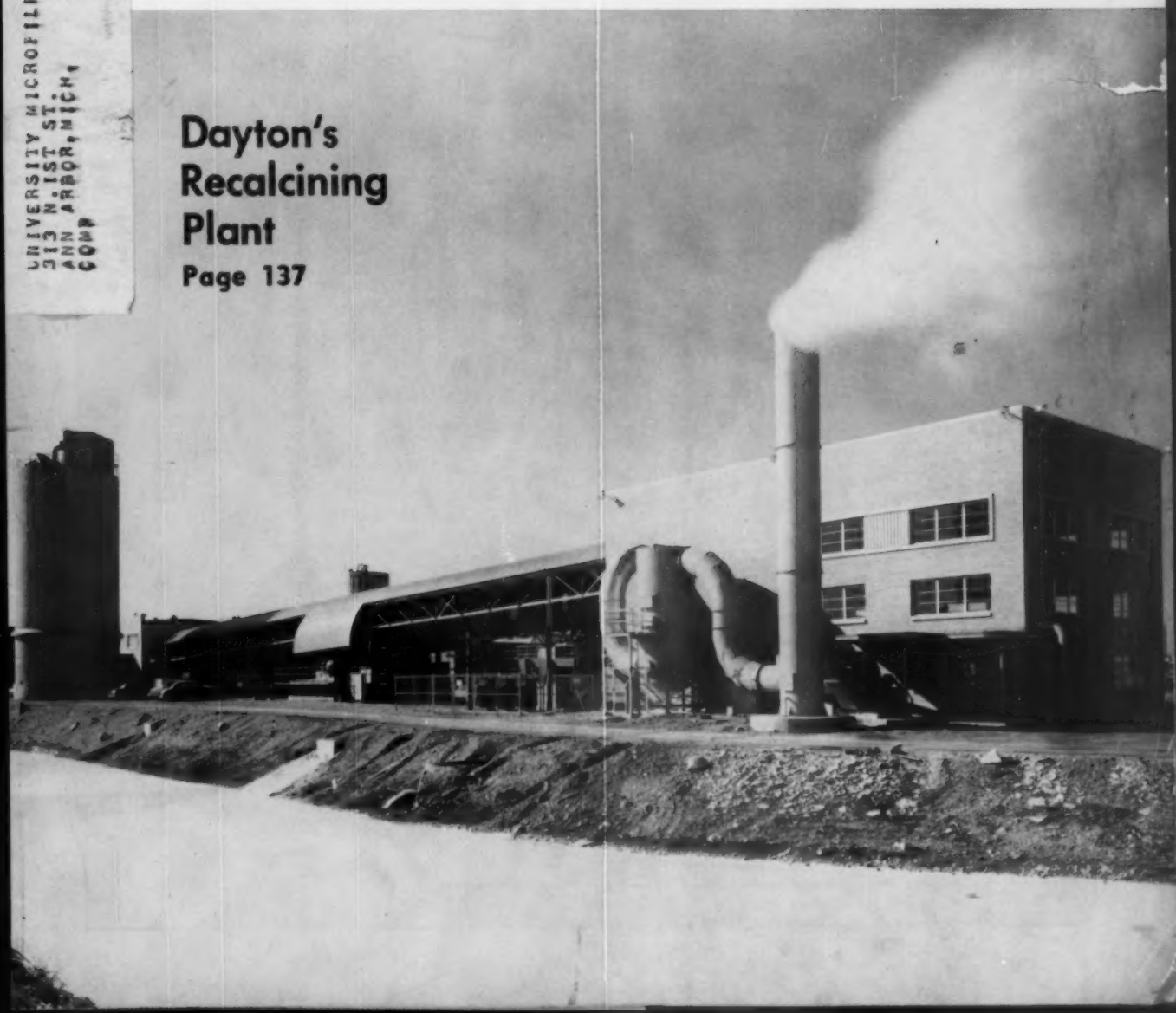
ANN ARBOR, MICH.
COMP

Dayton's Recalcining Plant

Page 137



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A Scranton Gillette Publication

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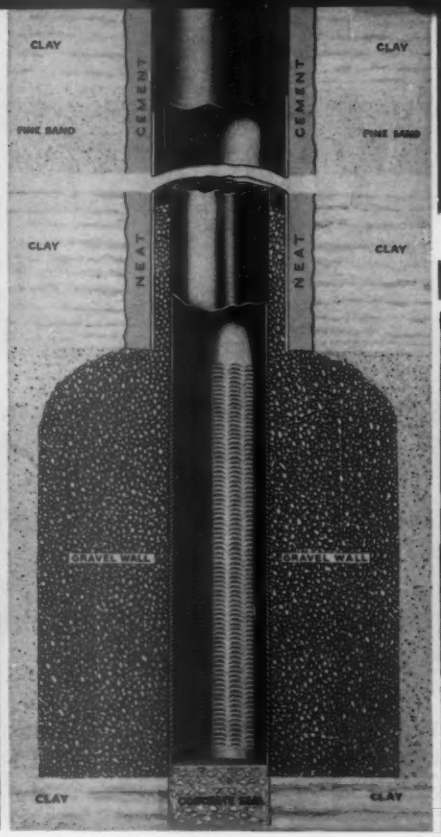

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Study of Anaerobic-Aerobic Sewage Ponds is a limnological investigation conducted by Washington State University's Industrial Research Division under a U. S. Public Health Service grant—Page 172.

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AN ADVANCED CONCEPT IN PNEUMATIC EJECTOR STATIONS

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  Delta-shaped outer shell completely encloses the air storage tank and sewage receivers of this duplex sewage ejector station. This unique design provides maximum protection for all components — plus easier maintenance and modification. Any component can be removed and replaced without removing the outer shell.
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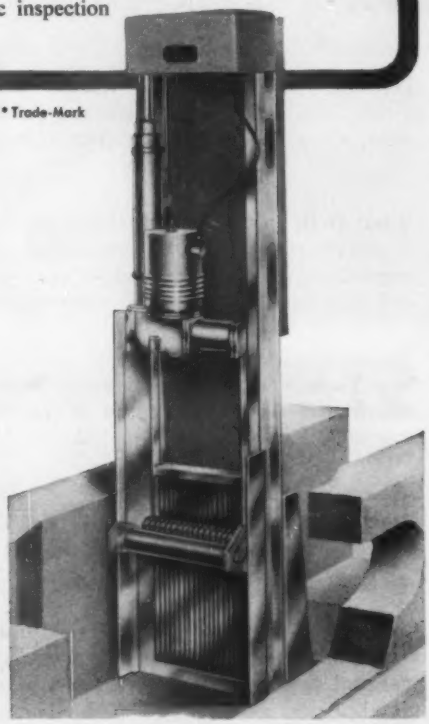
Model "A-1" BARMINUTOR . . . for use in rectangular channel sections 4 to 8 feet wide . . . sized for flows of 10MGD and upwards.



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News—Here & There

New York City Considers Roofing Reservoirs

New York City's Department of Water Supply has requested Mayor Robert Wagner to consider the possibility of constructing roofs over city reservoirs, particularly the one in Central Park. Preliminary studies have been initiated, and the Department has declared that roofing would not only protect the water supply but also make space available for recreational areas.

The reservoirs in question over 373 acres, ninety-six of which are in Central Park. The other reservoirs are Jerome Reservoir in the Bronx, Ridgewood in Brooklyn, Hillview, in Yonkers, and Silver Lake on Staten Island.

A preliminary estimate of the cost of the roofs, which would be supported on steel frames, was $48,600,000. The Department said that water from an open reservoir must be repurified because of pollution from the air and from birds. As a result, tap water in the City has had to be treated with chlorine at least three times. Covering the reservoirs would eliminate at least one treatment.

Camp, Dresser & McKee Move

The consulting engineer firm of Camp, Dresser and McKee have recently moved to larger quarters and are now located at: 18 Tremont Street, Boston, Mass. The company had been at their former address for about seventeen years.

Water Quality Symposium

The Public Health Service Announces a symposium on water quality data collection and utilization, to be held at the Sanitary Engineering Center at Cincinnati, Ohio, on August 23, 24, and 25, 1960.

The symposium will bring together representatives of organizations currently engaged or interested in establishment, instrumentation, and operation of water sampling networks and other related activities in water resources management. It will provide an opportunity to exchange information on objectives, organization, and operation of such networks; on the analysis and utilization of data; and on existing needs in the field of water quality measurement. Particular emphasis will be placed on automatic instrumentation.

When ready for distribution, the program will be sent to organizations and individuals known to be interested in this field. Anyone wishing to receive the agenda and other announcements may write to The Director, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, Ohio.

Paraguay Congratulates U.S. Firm for Water Job

Colonel Carlos Bobeda, representing the Paraguayan government, recently journeyed 7,000 miles from Asuncion, Paraguay, to Miami to convey his government's appreciation to Rader and Associates for their assistance on the newly completed $12 million municipal water system there.

The Miami engineering and architectural firm designed and supervised the construction of the entire supply, treatment and distribution system, and is presently supervising its operation. The project was financed largely by loans from the Export-Import Bank and Development Loan Fund which were granted on the basis of an economic feasibility report made by Rader and Associates in 1955. Operation of the system began last summer with service to date in 8,640 connections out of an eventual 20,000.

Present at a ceremony where Colonel Bobeda presented the firm with an official Paraguayan "Diploma of Honor" were: Samual T. Drew, project manager; John W. Greenleaf, Jr., partner in charge of the project; Col. Bobeda who read the communique; Earle M. Rader, senior partner; and Kenneth E. Calender, a partner in the firm.

Appalachian Underground Corrosion Short Course

The 1960 Appalachian Under ground Corrosion Short Course will be held at West Virginia University, Morgantown, W.Va., on June 1-3. There will be fifty-four classes and a number of field demonstrations.

The categories to be studied include: basic corrosion information; advanced corrosion information; intermediate-pipe; intermediate-cable; public water systems; pipe coatings; instruments; and special pertinent topics.

Last year, the 520 students who attended the short course received a copy of the proceedings which were contained in a 644-page book. The compilation included engravings and pictures.

Ohio Pollution Board Adopts "Get-Tough" Policy

The Ohio State Water Pollution Control Board has ordered a crackdown on the various cities and villages that are, apparently, stalling on the construction of adequate sewage treatment plants.

State Health Director, Dr. Ralph E. Dwork, declared that: "All indications are that the Board has exhausted its patience with these cities."

In Ohio, 72 villages dump raw sewage into open water. Twenty-one of these villages are building treatment plants, and the Board is closely following the actions or inaction of the other fifty-one.

Of fourteen cities dumping raw sewage, seven are building plants, and six are in the process of starting construction work.

Cochran Re-Named President By Clay Sewer Pipe Association

Member manufacturers of the Clay Sewer Pipe Association, Columbus, Ohio have re-elected A. G. Cochran of Columbus, president. Cochran, a veteran in the construction field, has a wide varied background in the clay pipe industry.

Hudson Hillyer of the Clay City Pipe Co., Uhrichsville, Ohio, was

CONTINUED ON PAGE 9A

Uses hundreds of

IOWA FIRE HYDRANTS and GATE VALVES

IOWA Fire Hydrants and Gate Valves form an important part of the more than $4,000,000 investment in water and sewage facilities for a completely new "City Within a City", a Perini-Westward development, entirely within the city limits of West Palm Beach, Florida. One of the owners is Louis R. Perini, Chairman of the Board of the Milwaukee Braves and President of Perini Corporation.

The eye-catching central pavilion dominates a 12-acre exhibit in the nine-square-mile area where more than 40,000 people are expected to live. Hundreds of Iowa valves and hydrants were installed to control the flow of water and provide fire protection throughout the 100 miles of cast iron water mains serving this $450,000,000 development.

The IOWA products were selected because of their proved long life and easy maintenance...plus the assurance that parts and replacements will be always available. Such longtime future service is an important part of every purchase of IOWA products.

One of hundreds of IOWA fire hydrants and gate valves being installed at Perini-Westward development within the city limits of West Palm Beach, Fla.

Let us send you details on IOWA'S *complete line of valves and hydrants*

IOWA VALVE COMPANY

Oskaloosa, Iowa

A subsidiary of James B. Clow & Sons, Inc.

News—Here & There

CONTINUED FROM PAGE 7A

named vice-president; and Mrs. Reva D. Smart of Columbus, was re-elected secretary-treasurer.

CSPA, a non-profit organization embracing twelve member manufacturers operating in the seventeen states north of the Ohio River and east of Indiana, also is a member of the National Clay Pipe Manufacturers, Inc., of Washington, D. C.

Missouri Studies Treatment Facilities

In an attempt to reduce an estimated cost of $2,500,000 for proposed facilities, a supplementary study of sewage treatment facilities for the Coldwater Creek watershed in the St. Louis area was authorized by the Metropolitan Sewer District Board of Trustees.

An earlier study of the Coldwater Creek watershed had set the estimated cost of a trunk sewer at $3,000,000 and of a treatment plant at $2,500,000. The supplementary study, to cost $4,000, will seek to determine whether a series of small treatment facilities would be cheaper to construct than a single sewage treatment plant on the Missouri River.

Third Manhattan College Conference on Biological Waste Treatment

Forty-five technical papers, including 10 from the countries of England, Germany, Holland, Japan, and Sweden, will be delivered at the Third Conference on Biological Waste Treatment at Manhattan College this coming April 20, 21, and 22.

Devoted to new advances in biological oxidation and oxygen transfer in the disposal of waste from industry and municipalities, the conference is unique in its field since it is international in scope and is the only meeting of its kind in the United States. Nearly 300 professional engineers are expected to attend, including representatives from education, industry, and federal and state governments.

Professor Eckenfelder, Conference Chairman, has indicated that the program will be divided into four categories: theory of bio-oxidation, recent advances in biological oxidation, oxygen transfer theory and developments, and bio-oxidation of sewage and industrial wastes. There will be two simultanious sessions with scheduled discussion periods after each session.

"Approximately half of the papers deal with basic research in the theory of biological oxidation and the theory of oxygen transfer," Professor Echenfelder said. "The remaining papers present new developments in biological waste treatment and aeration."

The three day conference will afford an opportunity for foreign scientists and engineers to present their findings to American specialists. "Since much significant work is being done on other countries," Professor Eckenfelder said, "the mutual exchange of information and ideas should stimulate further interest and promote continued research into the nature of waste disposal problem."

Paul Bunyan's Dinner

This water tank, a king-size replica of a corned beef hash can, provides skyline advertising for multi-million

dollar plant of Libby, McNeill & Libby construction in Chicago. The special structure, designed and built by Chicago Bridge & Iron Company, will hold 100,000 gallons of water to instantly supply the new plant's sprinkler system in case of fire. Reverse side of 130-foot high steel tank is painted to resemble a giant can of Libby's beef stew.

Tidal Water Pollution Gains Cited For New York Bay Area

Steady gains against the pollution of metropolitan New York waters were reported by the Interstate Sanitation Commission, which listed 133 sewage treatment plants in the tri-state district of New York, New Jersey and Connecticut, handling 1,417,100,000 gallons of sewage daily.

Thomas R. Glenn Jr., commission director and chief engineer, estimated that between 500,000,000 and 600,000,000 more gallons of sewage remained to be intercepted. He said New York City still has about a third of its sewage, or 400,000,000 gallons a day, remaining to be treated.

"It looks as if in two years most all of New Jersey will have all its domestic sewage receiving treatment, so that the problem then will be industrial waste," Glenn said. "Connecticut is in pretty good shape, except for one or two places."

He said the agency's minimum standard calls for water, at a depth of five feet below the surface, to maintain at least a 30 per cent saturation of dissolved oxygen. This, he added, is enough to allow fish such as carp to live in it, and other fish at least to pass through.

A commission survey found the Narrows, a neck of water between Brooklyn and Staten Island, to have a 53 per cent saturation in mid-1958. The agency predicted an improvement to 65 in mid-1965 and 70 by mid-1970. While the standard for recreational waters is 50 percent, the presence of disease-causing coliform organisms still would bar harbor waters for bathing, it said.

The district has 11,500,000 inhabitants. It runs from Bay Shore, L. I., to Sandy Hook, N. J., on the south; Arthur Kill, Newark Bay, and the Hudson River on the west, up to Bear Mountain Bridge; and eastward along Long Island Sound to a line between New Haven, Conn., and Port Jefferson, L. I.

The commission set up in 1936 to control pollution in tidal waters along 1,500 miles of metropolitan shoreline, said a 6.4-mile section of the Arthur Kill is below the minimum 30 per cent oxygen saturation requirement.

Washington Viewpoint

There's plenty of water resource development work ahead, if the Senate's Select Committee on National Water Resources is any judge. Chairman Robert S. Kerr (D., Okla.) said recently that "at least" $180 billion must be spent within the next 20 years if water supplies are to keep pace with growing population and economic pressures.

That committee, by the way, is compiling a vast amount of reference material, much of it available to interested engineers, in a series of "Committee Prints" of data assembled by various federal departments. Some of the titles recently issued: "Pollution Abatement" (Print No. 9); "Land and Water Potentials and Future Requirements" (Print No. 12); "Future Water Requirements for Municipal Use" (Print No. 7); "Evaporation Reduction and Seepage Control" (Print No. 23). You can get information on these by writing the Staff Director, Senate Select Committee on National Water Resources, Washington 25, D.C.

Another of these reports, incidentally ("Application and Effects of Nuclear Energy", Print No. 27) shows that scientists are already making use of the effects of nuclear bomb tests to trace groundwater supplies. The U.S. Geological Survey comments in the report that rainwater which has absorbed minute amounts of tritium because of bomb fallouts are being followed as they hit the ground, to see how they percolate into the earth, where they go, and how fast they travel. Delicate instruments apparently can identify the tritium, even to the point of whether the water came to earth as rain or snow. Tritium is harmless to human beings, and quantities may later be injected into water as it falls, for checks on earlier samples from test wells.

☆ ☆ ☆ ☆ ☆

Still another aspect of nuclear energy, as it affects water supplies, came under Congressional scrutiny late in March when the Joint Committee on Atomic Energy began a series of hearings into "Frontiers of Atomic Energy Research". Among principal matters discussed were use of nuclear energy for excavation and blasting, and in applications for desalinization of water.

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There will be no new stream pollution legislation this session, since the House—as you know—failed to override the President's expected veto of the Blatnik Bill (HR 3610) which would have nearly doubled presently authorized federal grants to communities for pollution abatement works. In floor debate, before the vote on overriding, Rep. John A. Blatnik (D. Minn) told the House he would "not be interested" in bringing out any other measure, should the veto be sustained. It's significant, though that many Congressmen have lost no opportunity to berate the President's stand on this matter, in the hope of keeping alive what they think may be a strong political issue.

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Under considerable prodding by Congress, Atomic Energy Commission has let a contract (to Cleveland Pneumatic Industries, Inc.) for a year-long study of two underwater disposal areas in the Pacific Ocean, where something over 24,000 concrete-encased drums of low-level radioactive materials have been dumped since 1946, at depths of more than a mile. The survey will consist of taking samples of bottom and

fish life, measuring currents, and attempts to photograph the bottom and the containers to see how well they have lasted over the years.

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Air pollution as a greater-than-local problem will get a continuing study, under terms of a bill (S. 3108) introduced by Senator Kuchel (R., Calif). The measure would instruct the U.S. Surgeon General to conduct public hearings on air pollution problems, extend the duration of the existing federal air pollution control law (which expires this July), lift the present $5 million annual ceiling on appropriations for this work.

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A full and comprehensive plan for joint U.S.-Canadian development of the Columbia River will be the final outcome of a meeting at Washington early in March, aimed at taking necessary steps to implement this work under sponsorship of the International Joint Commission. IJC, in previous sessions, had worked out preliminary agreements and now is looking toward written terms as to share of benefits to be divided between the two countries, methods of financing and the like. Biggest obstacle, at the moment, is the fact that Canada has declared that any development on its side of the border will be by a public agency, while on the U.S. side, numerous private organizations already have established power sites.

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Rising costs of land suitable for housing development is forcing use of areas that should never have been developed—and that's creating headaches for water supply and sanitary departments in every major U.S. population center. That's one of the reasons that the Housing and Home Finance Agency has announced it will join a three-way investigation of land costs and what can be done about them. Co-sponsors are the National Association of Home Builders and the Urban Land Institute. The six-month investigation will go into many aspects, including past practices in planning and developing residential land, and new approaches to development construction.

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If you're planning (or your community is) construction of welfare and recreational facilities, a recent Navy publication may be a valuable addition to your bookshelf. It includes information on design, construction and maintenance of swimming pools, auditoriums, gymnasiums and the like, including sanitary provisions. The report, PR 151980, "Special Service Facilities, is being distributed (for $1.75) by the Office of Technical Services, U.S. Department of Commerce, Washington 25, D.C.

☆ ☆ ☆ ☆ ☆

There's been a notable revival of Congressional interest in measures to give self-employed persons a break on income taxes, by means of allowing deductions for self-financed retirement plans (up to $2500 a year). You may remember that the House passed such a measure last session (HR10), but it has been buried in the Senate, mainly because the Treasury department has complained that it would lose something like $365 million annually if the bill was approved. But there has been a strong movement in the Senate to break the whole question loose again, and there seems to be some chance of action before July.

☆ ☆ ☆ ☆ ☆

On taxes, by the way, the Internal Revenue Service says that if you're on an expense account and must make regular accounting to your employer, you won't have to turn in any itemized statement on expenses with your 1960 tax next year. But IRS warns that you'd better keep careful records anyway, since it says it will "expect" taxpayers to produce substantiating records if demanded.

PIPE THAT DOESN'T GET COLD FEET IN WET TRENCHES

This cast iron pipe was installed to carry water to an important industrial site in Indiana.

At the time of installation, weather conditions were severe; the trenches were wet and muddy.

Still, the cast iron pipe was easily and speedily assembled, enabling the contractor to complete the job well ahead of the deadline.

Cast iron pipe does not get cold feet over rugged soil conditions. Its rugged design, corrosion-resistant qualities, and bottle-tight joints will withstand the most severe pressures.

Modern, cement-lined cast iron pipe will deliver a continued full flow of water for at least a century . . . and rarely requires repairs or replacement.

CAST IRON PIPE RESEARCH ASSOCIATION,
Thos. F. Wolfe, Managing Director,
3440 Prudential Plaza, Chicago 1, Illinois

CAST IRON PIPE
THE MARK OF THE 100-YEAR PIPE

starting . . .

a century of tax-saving service

permanent rust-resistant

CAST IRON PIPE

Today 68 American cities are still using cast iron water mains installed a century or more ago. No nonmetallic substitute has ever matched this record for longevity and long run economy.

Long life — lowest long run cost — are two of many reasons why Cast Iron Pipe is the best investment your community can make for new installations or extensions of water mains or sewer lines.

Lowest Maintenance Cost

Maintenance cost of Cast Iron Pipe is far below that of any other pipe material which has been in use long enough for the recording of conclusive data. This is due to its effective resistance to corrosion, its wide margins of safety in strength to withstand impact, beam and crushing stresses.

Finally, there's the factor of —

Re-use or Salvage Value

When water mains must be abandoned, re-routed or replaced by larger sizes, Cast Iron Pipe can be re-used or salvaged at a further substantial savings.

This advertisement is published in the interests of the Cast Iron Pressure Pipe Industry by .....

WOODWARD IRON COMPANY

Since 1882

WOODWARD, ALABAMA

Equipment News

And Now, Instant Concrete Pipe

401

Construction machinery that builds "instant concrete pipe" in a freshly-cut ditch at a rate of eight to twelve feet a minute has been developed by Fullerform Continuous Pipe Corp, Phoenix, Ariz.

Currently being used to build conduits for irrigation water on farms near Phoenix, the new construction process is being adapted to build storm sewers and other types of concrete pipe.

R. Fuller, inventor of the patented process, said his equipment eliminates joints and seams, cuts construction time and overall costs. Inflatable rubber and fabric forms, designed by Goodyear Aircraft Corp. engineers from blimp-type materials, are part of the continuous-operation system.

Using two 300-foot inflated forms with only three pounds per square inch of air pressure, Fuller can pour as much as 600 feet of concrete pipe at a time without interruption. It is possible to line up forms for runs in miles. Ready-mix concrete trucks are

used in a continuous stream to service the pouring equipment.

Developed over the past nine years, the construction process consists mainly of a double-hoppered forming machine that is pulled along the rounded bottom of a ditch, while enveloping an inflated inner form.

The inflatable "inner" form is picked up by the "outer" form so tamping devices can literally tuck concrete under it. Half of the double hopper, activated by electrically driven tampers, shoves concrete into the bottom of the ditch, while the other half is forming the top of the pipe.

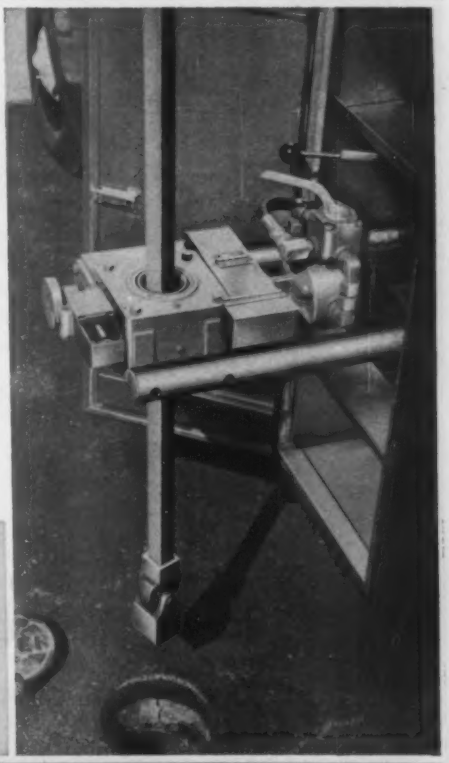
The hose-like, inflatable form, constructed of two plies of cotton fabric coated with neoprene rubber at Goodyear's aircraft plant near Phoenix, is open at both ends to hold air-tight bulkheads through which air pressure is applied for strength.

The new continuous pipe process, designed to be quicker and more flexible than prior metal-form attempts at monolithic pipe, is relatively simple since the inflatable form is easy to handle and can be deflated for extraction about two hours after the concrete has been poured. This makes possible use of the same form several times a day.

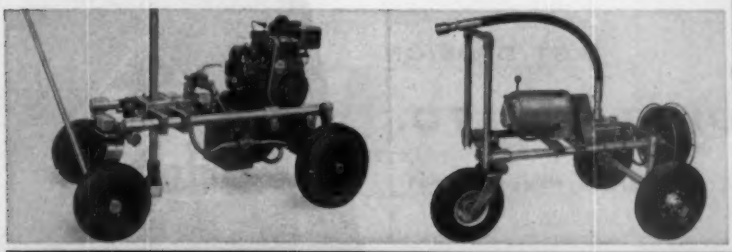
Machinery containing the "out-

CONTINUED ON PAGE 17A

HYDRAULIC TRUCK MOUNTED VALVE OPERATORS PROVIDE ONE MAN CONTROL OF VALVES FROM 10" TO 60" SHIPPED FULLY ASSEMBLED, FOR MOUNTING IN ANY MAKE OF TRUCK BY YOUR OWN MECHANICS, WITHIN A FEW HOURS. HAS SAFETY DEVICE FOR DAMAGE PROTECTION ALSO POSITION INDICATOR.



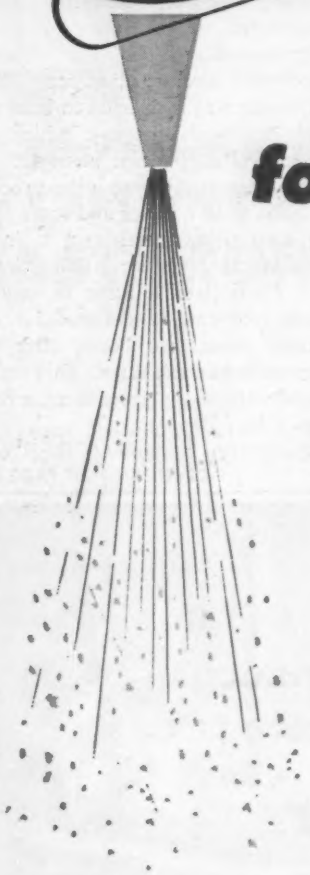
PORTABLE 3-10 HP. ELECTRIC DRIVE



Makes EVERY VALVE Power Operated. Payne Dean & Co. Clinton, Conn.

AST:

a dramatic idea for sludge disposal



An operation requiring one third less land than a conventional primary sewage plant. No digestion tank. No drying beds. A unit that takes sludge directly from the settling tank and reduces it to pure water and harmless ash in 60 seconds. Virtually automatic operation and a minimum of supervision. Absolutely no handling of material. A unit that can be adapted to any size community. A unit that is economical to build.

Such an idea is in existence. It is called AST (Atomized Suspension Technique). It was designed and built recently by National Welding Co. Ltd., for the town of Beaconsfield, Que.

AST is also eminently suited to disposal of industrial wastes.

Inquiries are invited from municipalities, industries and their consulting engineers.

AST DIVISION

NATIONAL WELDING CO. LTD.

8235 Mountain Sights Ave. Montreal, Que. Telephone: REgent 9-3241

NATIONAL

1984

Equipment News

CONTINUED FROM PAGE 15A

side" form for concrete pipe is set in the ditch and one end of the inflatable form is passed through it with bulkheads at both ends. When air pressure of the inner form is three pounds, the pipe-laying process is ready to begin.

As concrete is poured into the machine's double-hopper, the forming machine is drawn forward by a cable on a winch. An electric motor on top of the machine operates the tamping devices that distribute concrete uniformly and tightly around the inner form.

Fuller has developed inflatable forms in lengths from 50 to 300 feet and has laid pipe from 12 inches in diameter to 48 inches. He is now working on a machine and inflatable form to lay 60-inch pipe.

About 20 different machines were built by Fuller and his organization before they hit the right combination. Experimental tests by the dozens were made on Fuller's Arizona ranch. The tests were pure trial and error. Pipe was laid, then broken out to check for uniformity and strength.

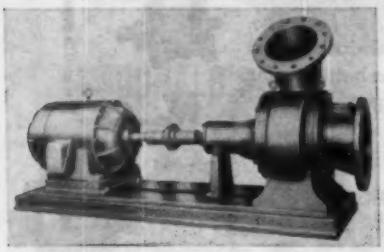
Although the first commercial installations have been limited to irrigation pipes, Fuller is convinced the new pipe-building process is not confined to this field.

He is currently working with the city of Phoenix on plans to lay storm sewers with his new system and perfecting methods to go after the vast sanitary sewer and other concrete pipe markets.

Solids Handling Pumps Now Available

402

Gould Pumps, Inc., Seneca Falls, N. Y., announces the availability of a broad line of heavy-duty process



pumps, designed to meet the most severe operating conditions encountered in the process and allied industries. With a capacity range up to 9500 GPM and for heads up to 220 ft., the pumps are especially adapted for handling: fluids with fibrous, granular or other type solids in suspension, whether abrasive or non-abrasive; thick liquids of all types such as paper stock, starches, slimes and slurries; and for operating under conditions where temperatures up to 350°F and working pressures up to 400 lbs. are encountered.

The pumps are of the end suction, vertically split type, featuring back pull-out assembly which gives ready accessibility to all rotating parts without disturbing pipe connections. All pumps have 45° self-venting discharge connections as standard. Top horizontal or vertical up discharge can be furnished on special order. Non-clogging, solids handling impellers with back ejecter vanes, external adjustment of clearance between impeller and renewable side plates, split

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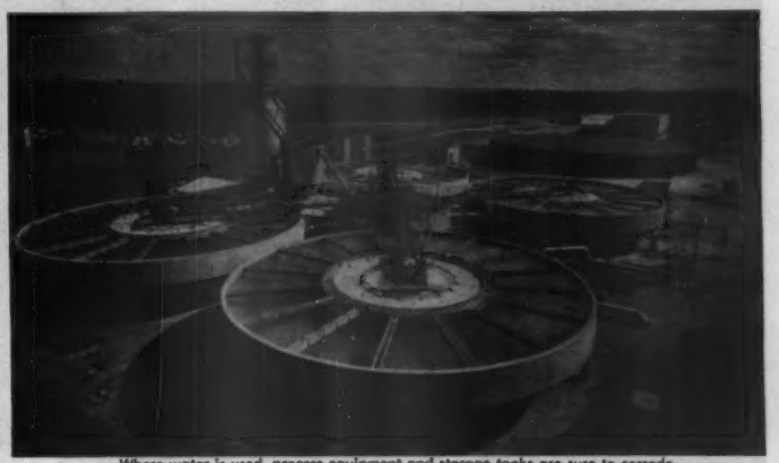


Where water is used, process equipment and storage tanks are sure to corrode unless protected by an E.R.P. cathodic protection system. Even with these concrete high rate clarifiers at the St. Regis Paper Company plant near Jacksonville, Florida, it pays to protect the metal parts with an E.R.P. cathodic system.

Engineering PLUS... E.R.P. cathodic protection pays off in maintenance savings

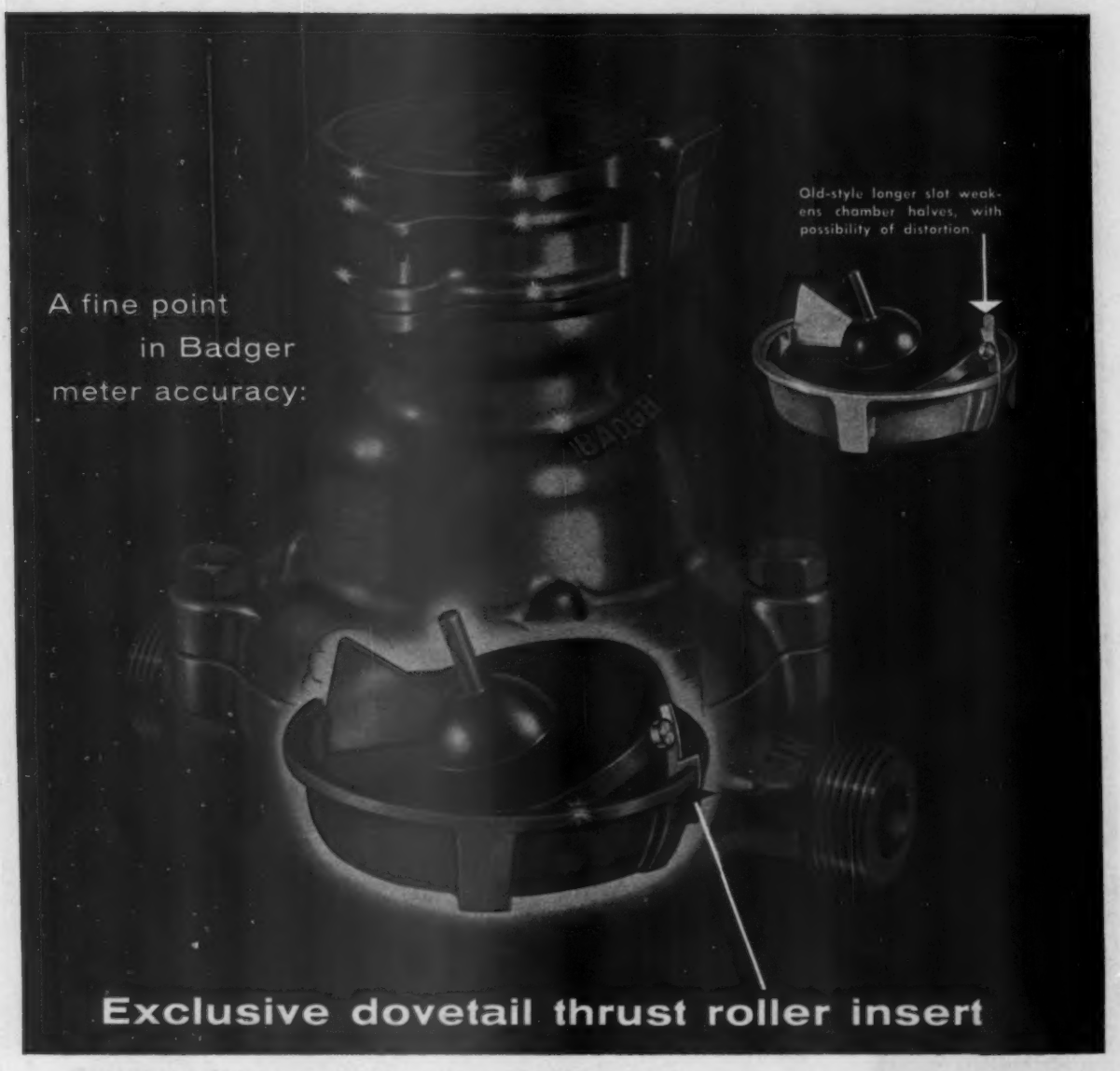
In industry or public service, water treatment is a big investment. To protect that investment in water treatment equipment could be a tremendous maintenance job. Even with concrete clarifiers, it pays to use E.R.P. cathodic protection. When there are metal tanks involved, just one cleaning and painting can cost more than a complete E.R.P. cathodic protection system.

From preliminary design to continuing periodic corrosion surveys, experienced corrosion engineers measure, analyze and design specifically for your corrosion problems. That is the only way corrosion can be virtually eliminated.

E.R.P. engineering plus prevents corrosion of water storage tanks, water and sewage treatment structures and pipelines. For full information on how E.R.P. can help you save maintenance costs, write for bulletin E-46.94.

ERP CATHODIC PROTECTION SINCE 1935

ELECTRO RUST-PROOFING CORP.
A SUBSIDIARY OF WALLACE & TIERNAN INC.
30 MAIN STREET, BELLEVILLE 9, NEW JERSEY
CABLE: ELECTRO, NEWARK, N. J.


A fine point
in Badger
meter accuracy:
Old-style longer slot weakens chamber halves, with possibility of distortion.
Exclusive dovetail thrust roller insert

cuts wear and noise at the water level

It's standard on all Badger Disc meters. Dovetail thrust roller insert fits vertically into the thrust roller slot to form a smooth track on which the roller rides countless times — quietly without wear. With the slot 77% shorter, original strength is retained and possible distortion in this area is eliminated.

Accurate registration is constant because the nutating disc never shifts position. After many years of service an inexpensive insert can be replaced if necessary (instead of a possible chamber replacement).

The dovetail thrust roller insert is just one of many refinements to emerge from Badger's concentration on *meter* research and development. For further details, see your Badger representative. Ask him, too, about the new Read-o-Matic outdoor meter-register. Proof that answers for better water metering come first from Badger.

BADGER'S BIG PARADE OF PRODUCTS FOR BETTER WATER METERING

Badger Water Meters

BADGER METER MFG. CO. • 4545 W. Brown Deer Rd., Milwaukee 23, Wisconsin • *Offices in Principal Cities*

Equipment News

CONTINUED FROM PAGE 17A

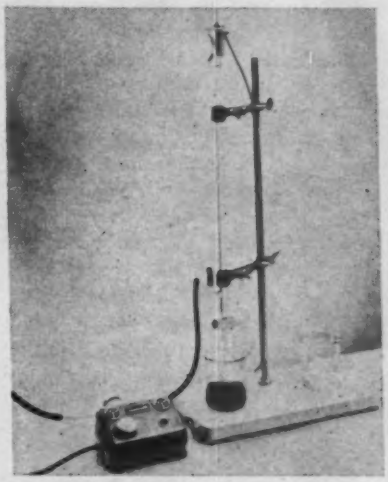
glands suitable for quenching and cooling chambers on bearing housings are other features that make these pumps particularly suited for heavy duty 24 hour service with a minimum of maintenance. Seven types of materials of construction are available including stainless steel.

Automatic Burette Filler

403

Coleman Instruments, Inc., Maywood, Ill., announces the availability of their new Model 27 Autofiller that is designed to decrease titration time as much as 30 per cent by eliminating the need for manual replenishment and adjustment of the burette contents to volumetric zero for each titration.

After each titration, the operator pushes a button on the control box; the Autofiller allows titrant to flow into the burette and stops it automatically when the titrant reaches a sensing probe placed at the zero level. The burette is thus filled exactly to the mark and is ready for the next titration.



The unit needs no drains or overflow traps, and can be used with any standard 5, 10, 25 or 50 ml, open top, side-fill burette and with any titrant sufficiently ionized to be electrically conductive.

Hills-McCanna Introduces Ball Valve Line

404

Hills-McCanna Company, Chicago, Ill., has announced a new line of ball valves. Major products in the new line are the McCannaseal and the McCannaflo ball valves, both of which provide the full flow of a gate valve, the tight shut-off of a globe or needle valve, and the quick quarter turn of the plug valve.

The new designs of these valves permit them to take temperatures up to 350 degrees F., and pressures up to 700 psi for the McCannaseal and up to 1,000 psi for the McCannaflo. They are constructed to handle practically all fluids, semi-solids, compressed gases, and compressed air. Pressure may be applied from either side, and the greater the pressure the tighter the seal.

Standard body metals include stainless steel, cast steel, ductile, iron, cast iron, or bronze. The valve balls are chrome plated carbon steel, bronze, or stainless steel. The valve sizes range from ¼" to 6" in screwed or flanged end connections.

CONTINUED ON PAGE 21A

McDONALD'S 104 YEARS OF EXPERIENCE STAND BEHIND THIS PRODUCT

McDonald 4701 Corporation Stop—Standard A.W.W.A. thread for copper service pipe. Sizes from ½ inch to 2 inches. A catalog of McDonald's complete line of brass goods is available on request.

A. Y. McDONALD MFG. CO., Dept. WS-460, 12th & Pine, DUBUQUE, IOWA • Brass Goods • Pumps • Oil Equipment • Drains

water

comes in oceans, rivers, lakes, wells,
drops, buckets, pitchers and glasses.
it quenches thirsts, cooks food, puts
out fires, makes coffee and
brushes teeth. it spins mills,
runs electro-plants, cools motors
and power factories.
it spawns fish, sprinkles lawns,
floats boats, washes children
and grows flowers.

it sustains and nurtures.
it bends if you give it purpose.
it reshapes itself if you give it reason.
it is needed, wanted, feared,
praised and prayed for.

it is at the heart of all life.
it is in the arteries of all industry.
it is as close to us as skin
but as taken for granted as sky.

the end of water seems unbelievable.
if it is not on the horizon, it is just over it.
if it is not within sight,
it is just 'round the bend.
if it is not in the glass,
it is just in the spigot.

. . . this is the grand mirage . . .
the self-delusion that prevails
though the wells run low
and the streams go dry
and the water slips away.

we know water.
we know its ways.
we've learned its habits.
we've pulled it out of swamplands,
pushed it over mountains,
pumped it into deserts,
tunneled it through granite,
and rescued it from pollution.

above all else,
we know the need for it.
that is why,
for 130 years,
we've developed new uses for,
powered new factories with,
diverted the courses of
and jealously stood guard over
water.

Fairbanks, Morse

A MAJOR INDUSTRIAL COMPONENT OF FAIRBANKS WHITNEY CORPORATION, NEW YORK

Whatever your pumping needs . . . whether your problem is flood control, irrigation, water systems, dams or reservoirs . . . whatever your concern with water may be . . . we can help you.

Our pumps . . . our generators and controls . . . our new rotary compressors . . . our drive toward better ways to de-salt ocean water . . . the potential of our advance Research & Development Center in Beloit . . . our lead position in the field of Hydrodynamics . . . all of these equip us to serve you.

Send for our brochure—"Hydrodynamics." Please write to Mr. Robert W. Kerr, President, Fairbanks, Morse & Company, 600 South Michigan Ave., Chicago 5, Illinois.

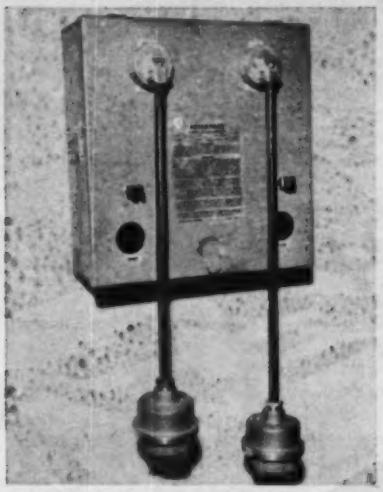
Equipment News

CONTINUED FROM PAGE 19A

Package Alternator for Duo-Pumps

405

Kenco Pump Division, Lorain, Ohio, has introduced a newly designed, compact, fully wired, complete package alternator for duo-pump installations. To connect this control to the pumps, it is only necessary to connect the pumps' 115 or 230-volt power supply to the alternator, set two liquid level controls to the desired turn-on and turn-off points, and plug in the pumps.



The following pump operations are possible: two pumps with two controls; two pumps with one control; one pump with two controls; or one pump with one control. This permits liquid to be distributed to two locations or two pumps to operate alternately, or it may provide for the automatic operation of one pump when desired.

Vertical, Magnetic Drive Line

406

Electric Machinery Mfg. Company, Minneapolis, Minn., has developed and is now marketing a new line of vertical magnetic drives. The line, manufactured under the trade name, Ampli-Speed, is designed particularly for pump drive applications.

Manufactured in five sizes, the Ampli-Speed can provide variable pumping speeds over a range from 0-1740 rpm. With variable speed pumping through the drive, pump speeds can be exactly matched to flow demands. A variety of sensing controls can be used to make pump operation completely automatic. In addition, the units have a built in speed control circuit which hold a pre-set drive speed to within ± 2 per cent.

The Ampli-Speed is air cooled. Technically, the unit may be called an eddy current slip device, utilizing two rotating members which "slip" with respect to one another. The drive control is all transistorized and is mounted in its own small cubicle.

It is built to match most vertical induction motors, or it can be built integrally with an E-M induction motor.

Portable Laboratory Recorder

407

Yellow Springs Instrument Co., Inc, Yellow Springs, Ohio, has announced production of their versatile Model 80 Laboratory Recorder which has five full scale calibrated voltage ranges, (10 and 100 millivolts, 1, 10, and 100 volts) and five scale calibrated current ranges (1, 10, and 100 microamps, 1 and 10 milliamps.) Its attenuator allows continuously variable full scale deflections between calibrated ranges.

The Model 80 can be operated as a zero left, zero center, or zero right recorder and provides 4 times full chart width expansion on all ranges. It can be operated grounded or floating up to ± 200 volts from ground. Its exclusive design gives it an input impedance of 1 megohn on all voltage ranges.

Besides its electronic flexibility, the Model 80 incorporates many mechanical features. It weighs only 11 pounds and is easily portable. It has a window for chart notation during operation, and is ready to record with no instrument warm-up or pen inking necessary. The unit contains a built-in chart take-up, and also has a device for obtaining tear-off records for short run observations. It comes equipped for 1 inch/hour and 15 inch/hour operation. Six additional speeds are available as auxilliary options.

John W. Wakefield (left), Director, Florida Department of Water Resources, and Sam A. Thompson, Chairman, Mississippi Board of Water Commissioners, view a huge enlargement of a Fairbanks, Morse water ad displayed at recent Interstate Conference in Chicago.

Wherever water experts meet Fairbanks, Morse is there

JUST as at the recent Interstate Conference on Water Problems... when water authorities get together, Fairbanks, Morse is a name known to all.

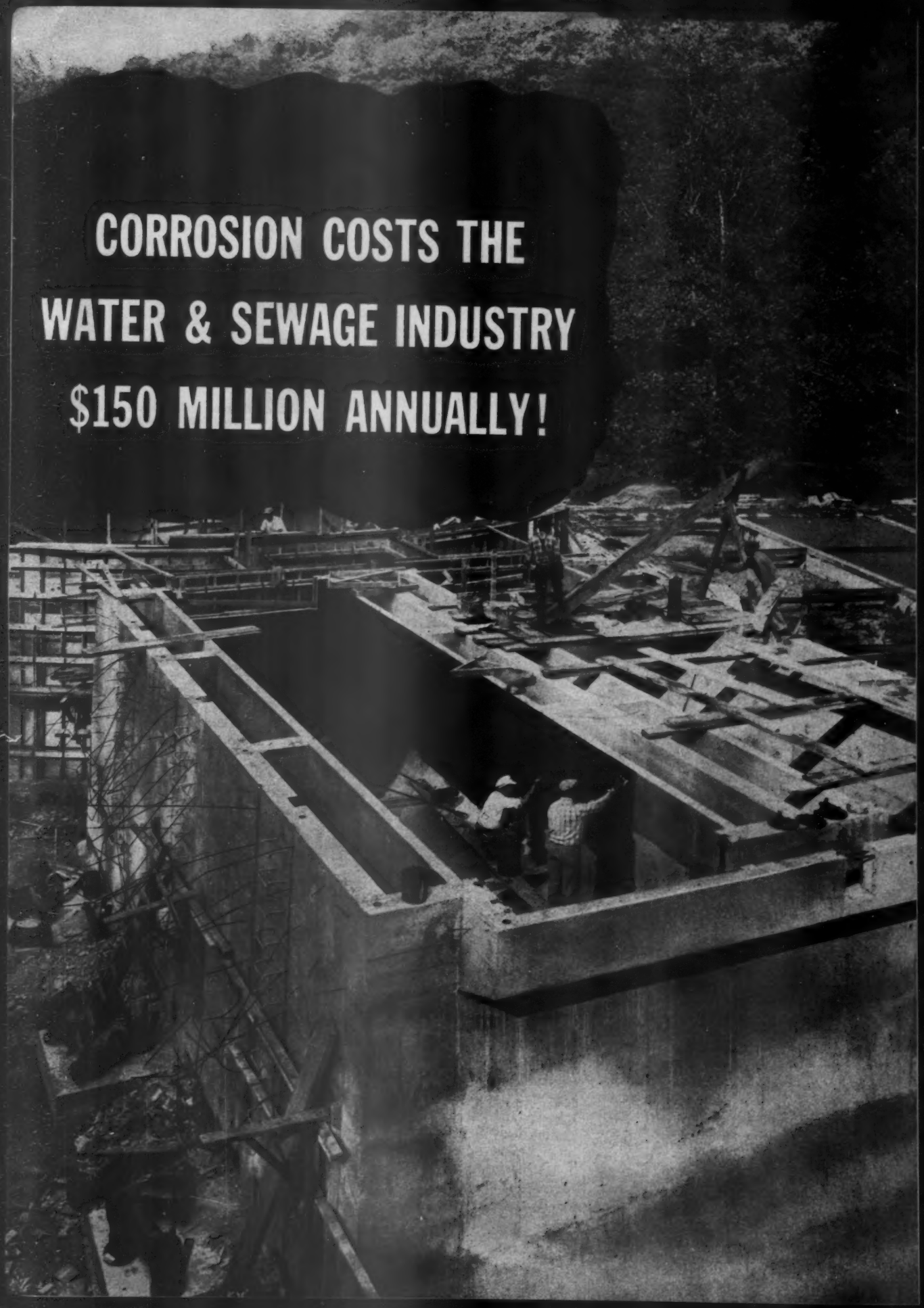
This is only natural, since no other manufacturer builds pumps for so great a variety of municipal hydraulic applications—from 200 gph to 800,000 gpm, and to 3000 psi. *Matched* F-M power units help assure lowest-per-gallon costs.

Confidence based on long buying experience explains why more local governments call for Fairbanks, Morse pumps than any other kind ... why F-M pumps are still, today, the "standard for comparison" wherever water experts meet!

Fairbanks, Morse

Pump and Hydraulic Division
Kansas City, Kansas

A MAJOR INDUSTRIAL COMPONENT OF FAIRBANKS WHITNEY CORPORATION, NEW YORK


CORROSION COSTS THE
WATER & SEWAGE INDUSTRY
$150 MILLION ANNUALLY!

Now You Can Control 96% of All Your Water & Sewage Corrosion Problems with this Proven PITT CHEM® Coating System!

Construction of water and sewage handling equipment costs almost twice as much today as it did 10 short years ago. That's why it's more important than ever to effectively protect your investment against corrosion—a "cost" factor that takes a $150 million toll in the water and sewage industry each year.

Water and sewage equipment is subject to a wide variety of corrosion conditions, some of which are the most severe in industry. More and more water and sewage maintenance engineers are turning to the complete PITT CHEM System of cold-applied coatings for long-lasting protection against corrosion. From ordinary moisture conditions to extreme chemical corrosion in digester tanks, PITT CHEM provides a coating tailored to stop corrosion and reduce your maintenance costs.

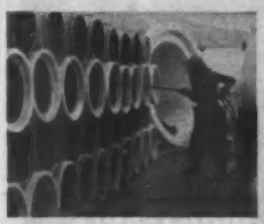
PITT CHEM Tarset, Tarmastic and Insul-Mastic are tough, *heavy* film coatings that outlast conventional maintenance paints 10 to 20 times. You measure their protection in *decades*, not years. They can be cold-applied by brush, spray gun or roller. No other family of protective coatings can solve so *many* of your corrosion problems so *economically*.

For more information, mail the coupon below. Then consult your nearest PITT CHEM Distributor—he's listed in the "Yellow Pages." Or call Pittsburgh Coke & Chemical Company in Pittsburgh, New York, Chicago, Houston or Los Angeles. A PITT CHEM Corrosion Engineer will be glad to discuss your corrosion problems.

PITT CHEM TARSET®

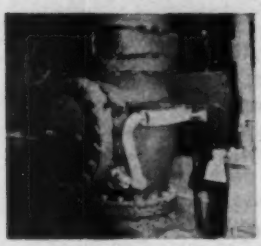
The original, patented coal tar-epoxy coating, Tarset is designed to control severest water and sewage corrosion. Widely used for protection of digester tanks, sludge vessels, filtering systems, and pipes carrying acid and alkaline waters. Specify Tarset for your toughest corrosion problems.

PITT CHEM TARMASTIC®



A broad family of coal tar coatings formulated to meet a wide variety of corrosive conditions at moderate cost. Concrete settling basins, steel structures, masonry foundations and tank bottoms are just a few of the many proven applications of PITT CHEM Tarmastic coatings.

PITT CHEM INSUL-MASTIC®



Vapor and moisture penetration problems can be effectively and economically solved with Insul-Mastic Gilsonite-asphalt coatings. Especially recommended as a durable weather and moisture barrier on metal, concrete and masonry surfaces. Insul-Mastic insulating cork mastics provide excellent condensation control.

PITT CHEM PIPELINE ENAMELS

PITT CHEM A.W.W.A. Plasticized Enamel conforms to American Water Works Association specification C203-57 and is widely used for external coating of potable water pipes and internal lining of potable water piping and storage tanks. Other Pitt Chem Pipeline Enamels are extensively employed by the gas and oil industries.

Send for Your Free Copy of this
WATER & SEWAGE CORROSION DATA FILE

Includes a survey of corrosion problems in the Water & Sewage Industry, data on PITT CHEM Coating Systems and a coating selector guide.

Name_____ Title_____

Company_____

Street_____

City_____ State_____

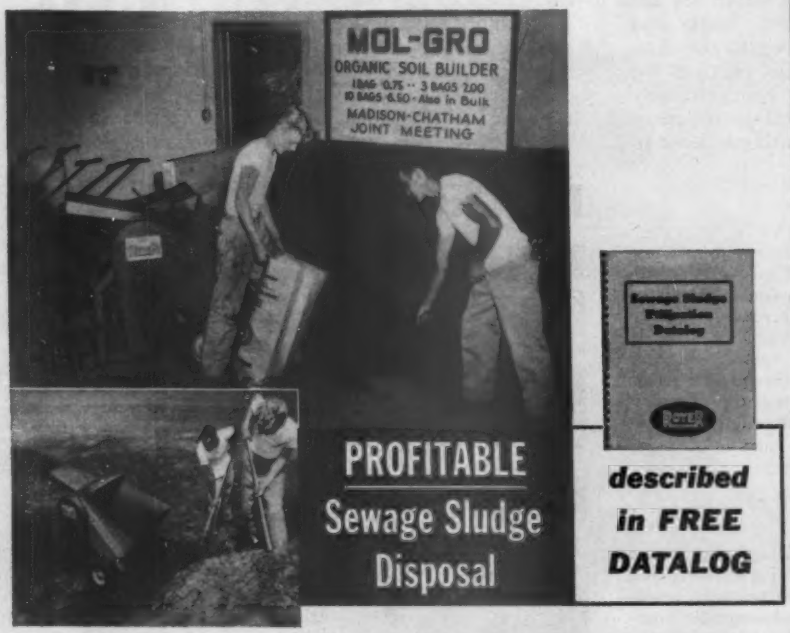
News of Suppliers

Swift To Head Dorr-Oliver Sales Division

Dorr-Oliver, Inc., Stamford Conn., has named Joseph V. Swift manager of the newly expanded South Central Sales Division. He has been with Dorr-Oliver for the past eight years, most recently acting as Sanitary Sales engineer in the company's Kansas City office.

The South Central Sanitary Sales Division markets water, sewage and industrial waste treatment systems and equipment in Arkansas, Kansas, Louisiana, Missouri and Texas. Dealings with consulting engineers, governmental units, and industrial purchasers in Missouri and Kansas were formerly handled by the D-O Central Division with divisional headquarters in Chicago.

Swift will continue to make his headquarters at the Kansas City office, which will now be the divisional headquarters for the expanded South Central Sanitary Division. He is a member of the W.W.A., the Water Pollution Control Federation and the National Society of Professional Engineers.



The Madison-Chatham (N.J.) Joint Meeting bags and sells their *Royerated sewage sludge cake*. While not big business, the operation does represent an additional source of municipal income.

The need for increasing municipal income, keeps growing in importance. The climate of today's economy warns against tax increases. Economies of operation are being searched for.

One of the most obvious economies that any organization can practice is the elimination of waste. Yet many sewage plants continue to dump or burn their sludge cake — throwing away or sending possible income up in smoke.

In April 1957, Royer published a new edition of their "Sewage Sludge Utilization Datalog," pointing the way to turning sewage from an expense into a profit. Since then, we've gone through two printings.

If your community is still destroying this source of revenue, write today—and learn how you, too, may experience *profitable sewage sludge* disposal.

Please send me a copy of your new edition of the information-packed "Sewage Sludge Utilization Datalog."

Name_____ Title_____

Plant_____

City_____ Zone____ State_____

☐ I am interested in a demonstration of the Royer Shredder at work.

ROYER FOUNDRY & MACHINE CO.

ROYER

170 PRINGLE ST.
KINGSTON, PA.

J. F. Heaney Named To K & M Post

Keasbey & Mattison Co., Ambler, Pa., has announced the appointment of John F. Heaney as sales service supervisor at the company's Perty Amboy plant. Heaney joined Keasbey & Mattison in September 1957.

Prior to his transfer to Perty Amboy in April 1959, Heaney was employed in the Company's New York district office. He has been in charge of customer service at Perth Amboy; and succeeds J. R. Purtell, who has been transferred to K&M, St. Louis, as head of the sales service department there.

Nalco Names Burns New Development Manager

Nalco Chemical Co., Chicago, Ill., announces that Robert R. Burns, formerly product manager for industrial process chemicals in the industrial division, has been appointed manager of a newly created commercial development department.

The new department will investigate and evaluate potential new markets and products and direct the marketing of new products until they are ready to be turned over to an operating division.

Burns is a chemical engineering graduate of Oklahoma A&M college and has been with Nalco since 1956. Earlier he was with the chemical division of Armour & Co. and with Allied Chemical & Dye Corp.

British Engineering Group To Form U.S. Subsidiary

The Richardsons Westgarth Group of Companies, Wallsend, England announce the formation of a U.S. subsidiary, Richardsons Westgarth Inc., with the main business office located in Washington, D. C.

Richardsons Westgarth Inc., has been formed to act as commercial and technical agents for U.K. products made by the Group and to act as main contractor on projects where a plant is manufactured in the U. S. to Richardsons Westgarth design.

The products made by the Richard-

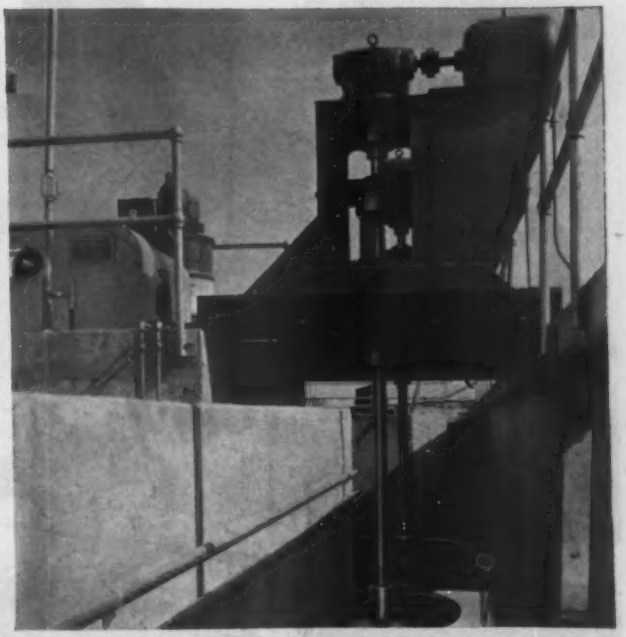
CONTINUED ON PAGE 29A

WHICH MIXING EQUIPMENT

provides most efficient flocculation?

LINK-BELT's combination of flash and straightline mixers assures chemical savings of 30 to 40% . . . increases filter runs by 50% . . . decreases wash water demands

FLASH MIXERS PROVIDE RAPID, THOROUGH MIXING of chemicals with water, sewage or industrial liquids. They consist of a constant-speed motor directly connected to a quiet-operating worm gear reducer. This drive, mounted on a pedestal, is connected to a vertical propeller shaft so mounted that *underwater bearings are not required.* Load and thrust of the propeller shaft are taken up by bearings in the pedestal so these forces do not act on the reducer bearings. This efficient design assures long life and trouble-free operation. The propeller itself is an iron casting designed for high mixing efficiency with low horsepower requirements. Link-Belt flash mixers may be installed in concrete, steel or wood tanks by mounting on a steel or concrete platform spanning the tank walls.



STRAIGHTLINE MIXERS PROVIDE GENTLE SLOW MIXING to build up maximum size floc. These mixers consist of a number of sections, each made of a horizontal solid steel shaft carrying steel angle arms on which redwood paddles are mounted. The paddle shaft is driven by a chain drive from a Link-Belt Electrofluid drive coupled to a Link-Belt P.I.V. variable speed drive. The solid steel paddle shaft, with rigid compression couplings insuring perfect shaft alignment, turns in special babbitted bearings with water lubrication grooves. These bearings eliminate grease contamination of the water and prevent breakdown that may be caused by failure to provide proper lubrication. Use of redwood for paddles eliminates painting maintenance. Link-Belt makes a complete line of these mixers. Size and shape can be adapted to suit local requirements.

The mixers shown above are part of the broad line of Link-Belt sanitary engineering equipment. Get in touch with the Link-Belt office nearest you. Our sanitary engineers will be glad to work with your engineers, chemists and consultants . . . help you get the finest in modern treatment methods. Or write for your copy of Equipment for Chemical Flocculation Book 2442.

LINK-BELT

SANITARY ENGINEERING EQUIPMENT

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. Sanitary Engineering Regional Offices—Colmar, Pa., Chicago 9, Kansas City 8, Mo., San Francisco 24. Sales Offices in All Principal Cities. Export Office, New York 7. Representatives Throughout the World. 10,011

See our exhibit—AWWA Convention, Miami Beach, May 15-20

"They wuz a little slow beginnin'... but look at 'em lay Tyton now!"

U.S. cast iron **PIPE** FOR WATER, SEWERAGE AND

everybody's doin' it

Laying Tyton Joint® pipe, that is. This easy-to-assemble pipe is so foolproof even a bear can get in the act. Only one accessory needed—a simple rubber gasket. No bell holes. No caulking equipment. No nuts or bolts to fiddle with. No weather worries, either. Tyton doesn't mind wet feet . . . can be laid in rain or wet trench. Result: more working days, more lengths laid per man hour, lower installation cost. Sound interesting? It is! Call or write for the facts.

U.S. PIPE AND FOUNDRY COMPANY
General Office: Birmingham 2, Alabama

A Wholly Integrated Producer from Mines and Blast Furnaces to Finished Pipe.

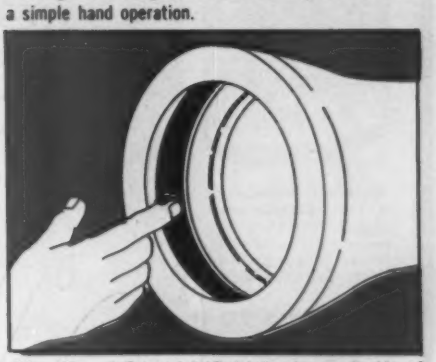
INDUSTRIAL SERVICE

CAST IRON®

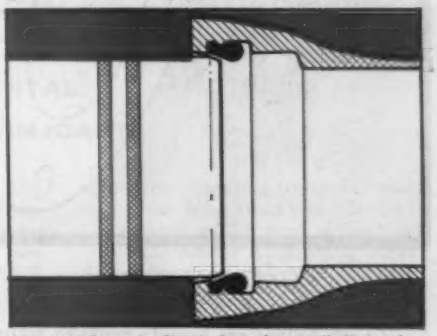
TYTON®

ONLY FOUR SIMPLE ACTIONS

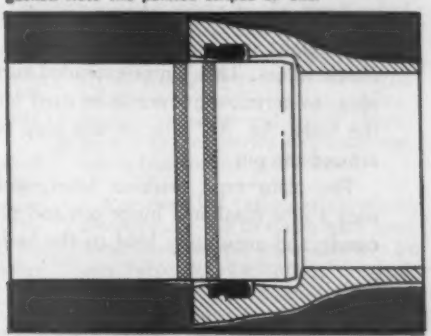
Insert gasket with groove over bead in gasket seat . . . a simple hand operation.



Wipe film of Tyton Joint® lubricant over inside of gasket. Your receiving pipe is ready.



Insert plain end of entering pipe until it touches gasket. Note two painted stripes on end.



Push entering pipe until the first painted stripe disappears and the second stripe is approximately flush with bell face. The joint is sealed . . . bottle-tight, permanently! The job's done . . . . fast, efficiently, economically. Could anything be simpler?

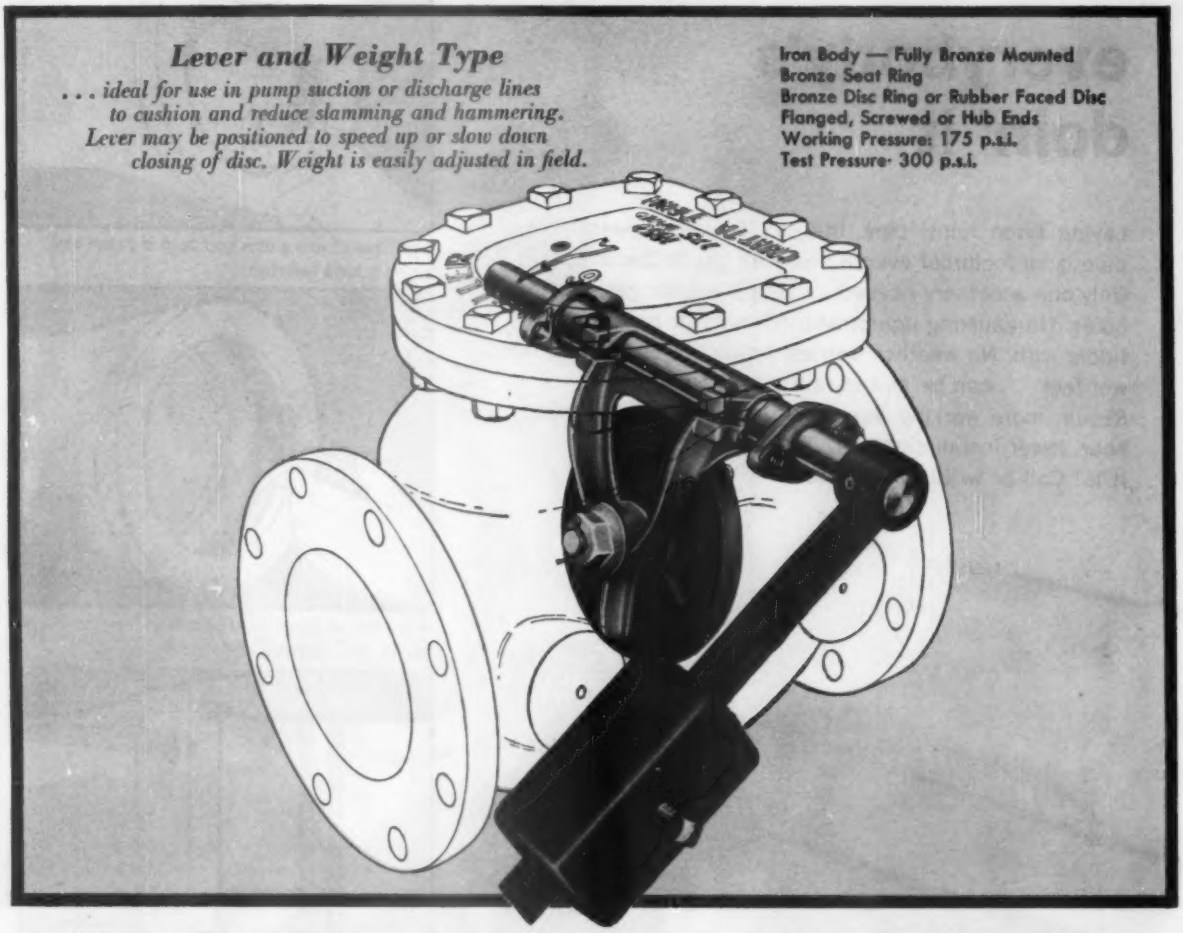
MUELLER® Check Valves

heavy duty disc assembly that lasts and lasts!

Lever and Weight Type

. . . ideal for use in pump suction or discharge lines to cushion and reduce slamming and hammering. Lever may be positioned to speed up or slow down closing of disc. Weight is easily adjusted in field.

Iron Body — Fully Bronze Mounted
Bronze Seat Ring
Bronze Disc Ring or Rubber Faced Disc
Flanged, Screwed or Hub Ends
Working Pressure: 175 p.s.i.
Test Pressure- 300 p.s.i.



All working parts of these new Mueller Swing Type Check Valves are heavily made to assure long service life and dependable operation *without maintenance.*

A heavy stainless steel hinge pin is used on all lever and weight type (shown) and lever and spring type check valves. This pin is extended through the hinge plugs to permit the lever to be used on either side of the body. An "O" ring on the plug prevents leakage around the pin.

The plain type, without lever, weight or spring, uses a new combined hinge pin and plug which is securely and accurately held to the body by studs and nuts. An "O" ring positively seals the plug to prevent leakage.

Large, wear-resistant bearings and a full-width clapper arm hinge, used in all types, accurately and rigidly align the disc to eliminate chatter and vibration.

These new, heavy duty check valves have been specifically designed for repeated opening and closing applications in water works pumping stations, water filtration plants, sewage treatment plants and general industrial plants. They are suitable for horizontal or vertical installation on water or oil lines.

Write for specifications.

The many exclusive features of these new check valves are typical of the attemtion to detail in research, design and engineering that becomes a part of every Mueller product.

MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles;
In Canada: Mueller, Limited, Sarnia, Ontario

News of Suppliers

CONTINUED FROM PAGE 24A

sons Westgarth Group include a wide range of land equipment—steam and gas turbines, condensing and feed-heating plant, axial and centrifugal blowers, boilers, complete power station plants also sea water distillation and heat exchange equipment for the water supply utilities, petroleum, chemical, metals and other industries requiring low cost potable and process water of high purity.

Hagan Expands Research Operations

Hagan Chemicals and Controls, Inc., Pittsburgh, Pa., have expanded their research operations which will

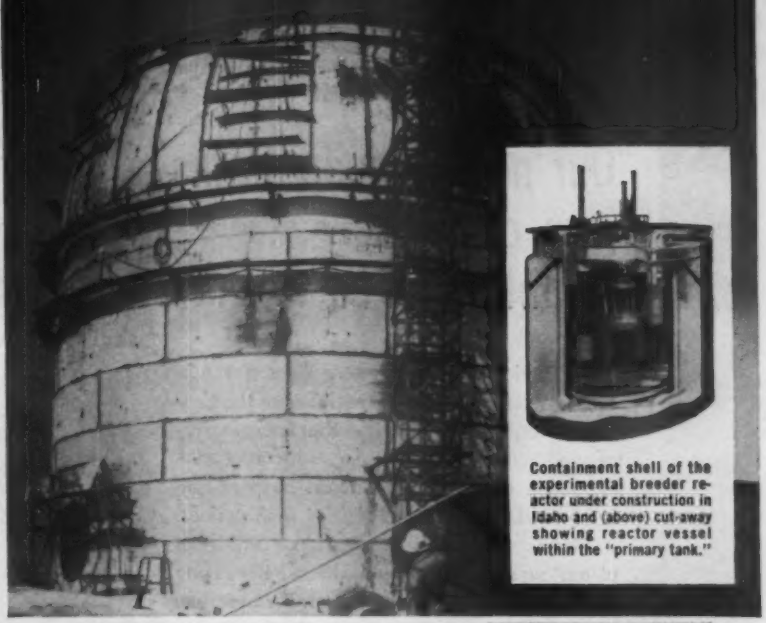
now be carried out in a newly dedicated center. The second such research facility completed in the last two years, the new building will house a pilot chemical laboratory, research and development facilities for pneumatic controls systems and components, a model shop for prototypes and experimental control devices, and an electronics laboratory for Kybernetes data processing equipment and Powr-Mag electronic control equipment.

Pollock Appointed By Ohmart Corp.

Ohmart Corporation, Cincinnati, Ohio, has announced the appointment of Earl M. Pollock as Vice-President. The Cincinnati firm manufactures gauging and control systems using a principle of converting atomic radiation directly into electrical energy, for the close-tolerance measurement of liquid levels, interface level, slurry density, specific gravity, and other applications. Mr. Pollock will be responsible for directing the Corpora-

CONTINUED ON PAGE 100A

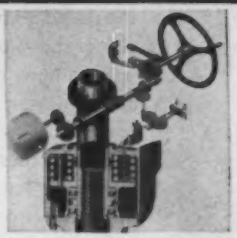
ARGONNE NATIONAL LABORATORY WILL USE...



Containment shell of the experimental breeder reactor under construction in Idaho and (above) cut-away showing reactor vessel within the "primary tank."

ELECTRODYNE.
AUTOMATIC VALVE CONTROLS

FOR EXPERIMENTAL BREEDER REACTOR IN IDAHO



Electrodyne will be used by the Argonne National Laboratory as the control for the reactor vessel cover hold-down mechanism in the new experimental breeder reactor EBR II at the National Reactor Testing Station near Idaho Falls, Idaho.

EBR II is a "closed cycle" power plant, where nuclear fuel will be employed to produce heat and at the same time make additional fuel by a "breeding" process. The partly spent fuel and the new fuel that has been bred can then be reprocessed and refabricated into new fuel elements right in the EBR II facility.

Electrodyne is an integral part of the EBR II design controlling the hold-down mechanism for the cover of the fuel chamber which will be submerged in liquid sodium. This reactor has been planned to demonstrate the "breeding principle" that more fuel (plutonium) can be bred from uranium-238 than is used up while the reactor is operating. EBR II has been designed to produce usable electricity from atomic energy.

For customer applications, *Electrodyne* thrust limiting features assure positive, automatic control and complete safety in the handling of the most critical materials.

This again illustrates the versatility of *Electrodyne* as a valve-type control for a wide variety of applications in chemical and power plants, oil and gas industries and water and waste treatment installations.

For detailed information about *Electrodyne*, get in touch with your local *Electrodyne* representative or any valve manufacturer.

HUPP AVIATION Division
6633 WEST 65th STREET • CHICAGO 38, ILLINOIS

ELECTRODYNE VALVE CONTROLS . . . HYDROID GEAR PUMPS AND MOTORS . . . PRECISION INDUSTRIAL, AIRCRAFT AND MISSILE GEARING AND COMPONENTS

WILLIAM KERIVAN, Chief Filter Plant Operator, Billerica (Mass.) Water Treatment Plant, says:

"Our porous underdrains give completely trouble-free service..."

Mrs. Barbara E. Hawkes, Chief Chemist, checks backwashing of Billerica's #1 filter.

The Billerica Water Treatment Plant serves 26 square miles, supplying 1.0 MGD from the Concord River. Beds for Billerica's four filters are 30" of sand and 18" of anthracite, with ALOXITE® aluminum oxide porous bottoms. Average load is 1.5 MGD and 2.0 MGD during peak periods.

"What we like most about the ALOXITE plates," says Mr. Kerivan, "is that we have none of the problems of graded gravel. For example, the large photo, taken during backwashing, clearly shows no blow holes such as you run into with an upset gravel bed. Scum is removed easily and uniformly. As for mudballs, they're just a name to us—we don't have them.

"The porous plates have had no repairs since they were installed four years ago. Their only maintenance consists of acid cleaning once a year. Judged from our experience, these bottoms have no shortcomings."

CARBORUNDUM

Registered Trade Mark

Dept. X-20, Refractories Division, Perth Amboy, N. J.

ALLIS-CHALMERS

Trail of service that never sleeps

Backing up the broad line of Allis-Chalmers products are more than 200 field installation and service men. Available day or night, they respond promptly to the emergency needs of A-C customers.

Hundreds of other facilities, strategically located, guarantee lifetime service support to Allis-Chalmers products wherever they are applied.

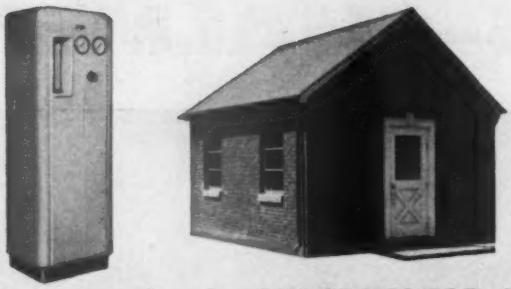
Regional offices are located in key industrial cities. **District offices** across the country cover every city or area wherever Allis-Chalmers equipment is used.

Certified service shops are only minutes away for expert round-the-clock service.

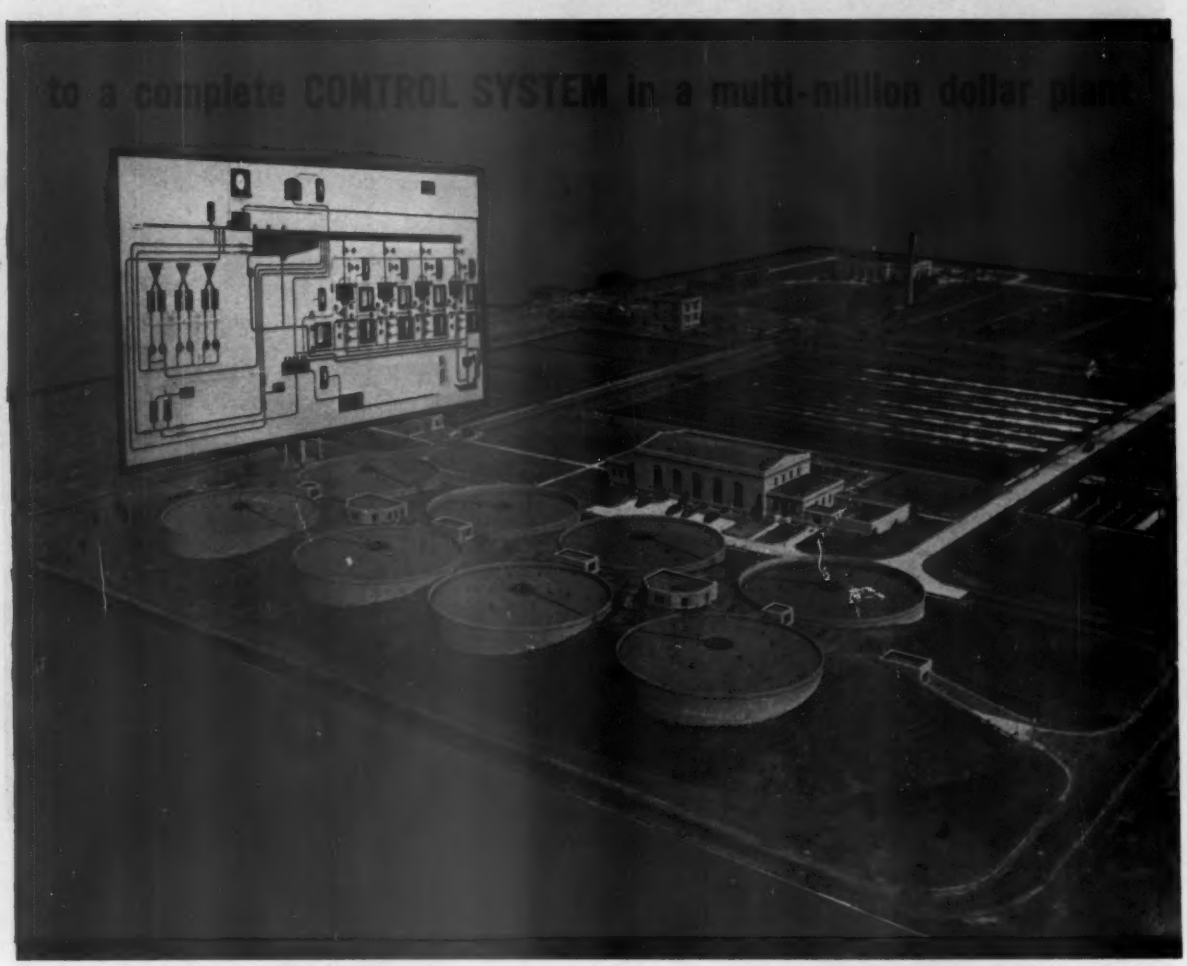
Warehouse stocks are within easy reach of all these service teams for fast delivery.

Ask your A-C representative about this coast-to-coast service organization, and the lifetime service support behind every A-C product, or write, call, or wire Allis-Chalmers, Milwaukee 1, Wisconsin.

"Teamed" Equipment from Allis-Chalmers — pumps, motors, motor-generators, motor control, condensers, blowers, hydraulic turbines and generators, water conditioning, transformers, switchgear, butterfly valves, diesel engines. A-1213



from a simple CHLORINATOR in a pumping station



for water, waste, and sewage treatment

. . . consult Fischer & Porter first! Contact the Fischer & Porter field engineer serving you . . . or write Fischer & Porter Company, 140 Fischer Road, Warminster, Pa. In Canada, write Fischer & Porter (Canada) Ltd., 2700 Jane St., Downsview, Ontario.

FP FISCHER & PORTER CO.

Instrumentation & Chlorination

"But Mayor! They promised my pump last month!"

"A lot of good that penalty clause is doing us . . . a penalty clause won't pump water . . . and the money the manufacturer loses won't keep our water customers happy. I knew we should have put in an experience clause, too, Mayor. Promises are no better than the outfit that makes them, and we sure got a hold of some amateurs this time. I guess you can't buy both delivery *and* price!"

This integrity . . . this ability is one of the inherent qualities you get when you buy Allis-Chalmers. General Products Division, **Allis-Chalmers,** *Milwaukee 1, Wisconsin.*

A-1241

ALLIS-CHALMERS DELIVERS ON TIME

At Allis-Chalmers we have accepted penalty clause contracts because we know that in 99% of the cases we can deliver. That 99% is an actual fact, based on many years of experience in supplying pumps to municipalities. We have the resources and the manufacturing facilities to get pumps **delivered when promised.**

H_2SiF_6

HYDRO FLUO SILICIC ACID

THE ROLE IT PLAYS IN

MUNICIPAL WATER FLUORIDATION

Controlled fluoridation of communal water supplies is rapidly becoming a standard process of water treatment. And, as the process gains in popularity across the nation, so is the use of hydrofluosilicic acid gaining increased recognition because of its superiority to solid fluoride salts on many counts. The chief advantages are lower cost, greater safety and a secure source of supply. They are important considerations for any city official charged with the dual responsibility of maintaining public health and, at the same time, administering municipal funds. They deserve a closer look.

Lower cost • The economy of hydrofluosilicic acid stems from several sources. Because it is a liquid and can be shipped in tankcars and tank trucks, transportation costs are lower. Tankcar freight rates are the lowest available.

Less storage space is required, as well as less handling. Hydrofluosilicic acid can be pumped directly from the shipping or storage container into filtered water conduits, resulting in substantial savings in direct labor. On the other hand, fluoride salts require extensive feeding equipment — dry feeders, dust control, dissolving tanks, hoppers, agitators — whereas a fluoride liquid can be handled easily by a proportionating pump or other standard solution-type feeder.

Greater safety • The liquid state of hydrofluosilicic acid completely eliminates the health hazard of fluoride dust — an ever-present threat to anyone handling fluoride salts. Costly safeguards are eliminated, too. No special handling equipment is needed. No separate storage rooms, exhaust fans, expensive ductwork or other special protective equipment. Hydrofluosilicic acid requires a minimum of handling, with maximum safety.

Unlimited supply • Hydrofluosilicic acid is a recovery product. It is derived from the process of converting phosphate rock to superphosphate. And, since *International* is the largest domestic producer of phosphate rock, you are assured of a dependable source of supply both today and in the years ahead.

For additional information on physical and chemical properties, methods of analysis and water fluoridation dosages, send your specific questions to *International* at the address below.

International Minerals & Chemical Corporation
Dept. WSW-16, Skokie, Illinois

Gentlemen:
Please send additional information on *International* Hydrofluosilicic Acid. I am particularly interested in:
☐ Water fluoridation ☐ Other uses

Name.....

Street.....

City.....Zone.....State.....

IMC

*Trademark

Products for Growth *

INDUSTRIAL CHEMICALS DEPARTMENT

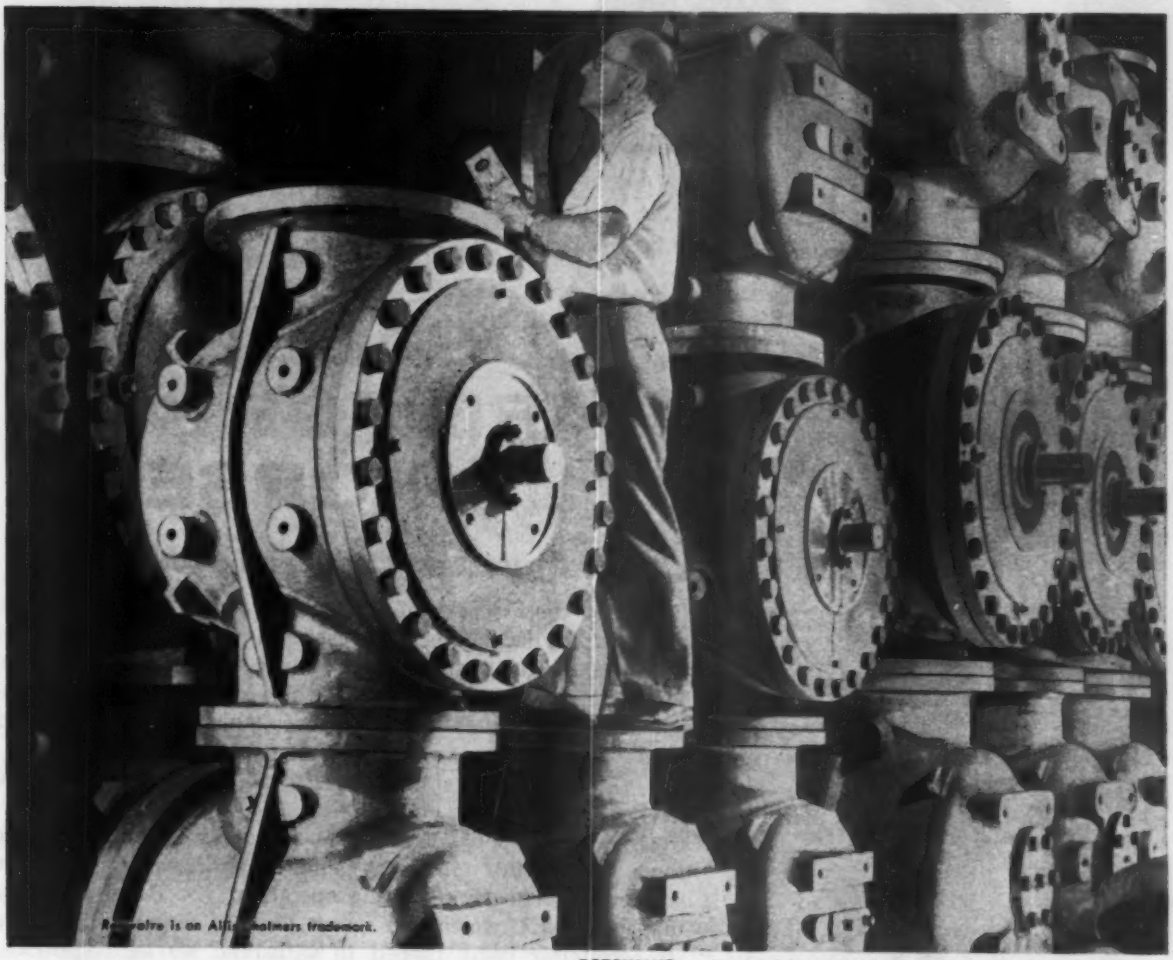
INTERNATIONAL MINERALS & CHEMICAL CORPORATION

Administrative Center: Skokie, Illinois

16-60

ALLIS-CHALMERS

A-1260



ROTOVALVE stocks at A-C York Works save months of delay for customers.

Another Allis-Chalmers time-saving exclusive:

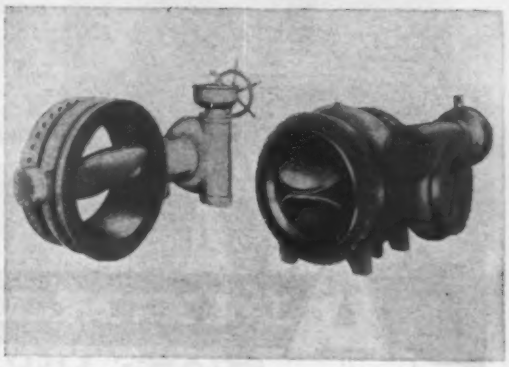
Cone valves "right off the shelf!"

Six to thirty-inch *Rotovalve* units — awaiting your call. Think of the valuable time you save! Typical is the case of a western municipality that recently needed one 24-inch and three 20-inch *Rotovalve* units for their waterworks. Allis-Chalmers assembled all accessories required, completed testing and shipped the valves to customer in less than three weeks! Compare this with the 3 to 6 months normally required by other suppliers for delivery.

Perpetual off-the-shelf inventory of *Rotovalve* units, butterfly and ball valves gives Allis-Chalmers today's only complete rotary valve-stocking program . . . guarantees fastest deliveries to you.

Avoid troublesome, costly delays and get the valves you need to do the job right. For immediate assistance anytime, call your nearby A-C valve representative, district office or write **Allis-Chalmers,** Hydraulic Division, York, Pa.

Rotovalve is an Allis-Chalmers trademark.



Standard butterfly and ball valves illustrated are also available from stock in a broad range of sizes.

"SADDLES ARE FOR HORSES"

...not American Cast Iron Pipe!

Too often the first cost of the material is the only factor considered when deciding between cast iron pipe or a substitute. To give sole thought to the cheaper substitute piping is, in a sense, false economy because many times this lower initial cost is misleading and obscures added expenses which must be incurred later.

Yes, the first cost may be cheaper... but cast iron pipe offers so much more.

Consider tapping. For reliable, economical water service, the tapped main must meet four definite requirements: (1) Have strength to withstand tapping operation; (2) Be of an *easily* tapped material which will assure *uniform* threads; (3) Have strength after being tapped to withstand service conditions; (4) Have threads that will provide tight connections after exposure to service stresses. *Cast iron pipe meets all of these tapping requirements.*

When tapping substitute piping, it is often necessary . . . to employ skilled workmen with special equipment... to utilize tapping saddles... to use extreme care in order to make a connection that does not leak.

Remember... tapping saddles are an extra expense and are *not necessary to make service connections to cast iron pipe.*

AMERICAN
CAST IRON PIPE CO.
BIRMINGHAM ALABAMA

SALES OFFICES
New York City • Dallas
Chicago • Kansas City
Pittsburgh • Denver
Minneapolis • Orlando
Birmingham • Cleveland

Look for this New Name at the 1960 AWWA Convention Bal Harbour, Fla. May 15-20

HERSEY-SPARLING Meter Company

We look forward to welcoming you at our first Convention appearance since the Hersey Manufacturing Company and the Sparling Meter Company joined together "under one banner".

At the Hersey-Sparling booth we can give you full details on the world's most complete line of water measuring and control equipment for Municipal, Industrial and Irrigation Service. We will be glad to see you.

Hersey-Sparling Meter Company; Hersey Products: Dedham, Mass.; Sparling Products: El Monte, California; Branch offices in all principal cities.

Booth Numbers 97—100

Springfield, Illinois, sewage plant. In foreground, three Verti-Flo Clarifier Basins. *Inset:* Partitioning baffles divide tank into efficient vertical-flow cells. V-notched weirs control cell-to-cell flow, minimize short-circuiting. Each basin equipped with two longitudinal and one cross collector.

C. C. Larson, district manager, Springfield Sanitary District; A. Paul Troemper, district engineer; Jenkins, Merchant & Nonkivil, consulting engineers.

REX® Verti-Flo® Clarifiers boost capacity, reduce space

Thousands of dollars in valuable plant space were saved when consulting engineers and the management of the Springfield, Illinois, Sanitary District selected Rex Verti-Flo Clarifiers for their recent plant expansion. In addition, their selection provides for economical plant growth in the future.

Rex Verti-Flo's unique design gives Springfield over twice the capacity of conventional clarifiers—in the SAME amount of space.

An exclusive operating principle provides this increased capacity: a system of multiple cells changes the flow from horizontal to vertical. The main body of each Verti-Flo tank is proportioned into four cells with a generous weir length around each.

Another important reason why Verti-Flo operates efficiently at higher overflow rates is this: it allows a tank to be hydraulically balanced after construction.

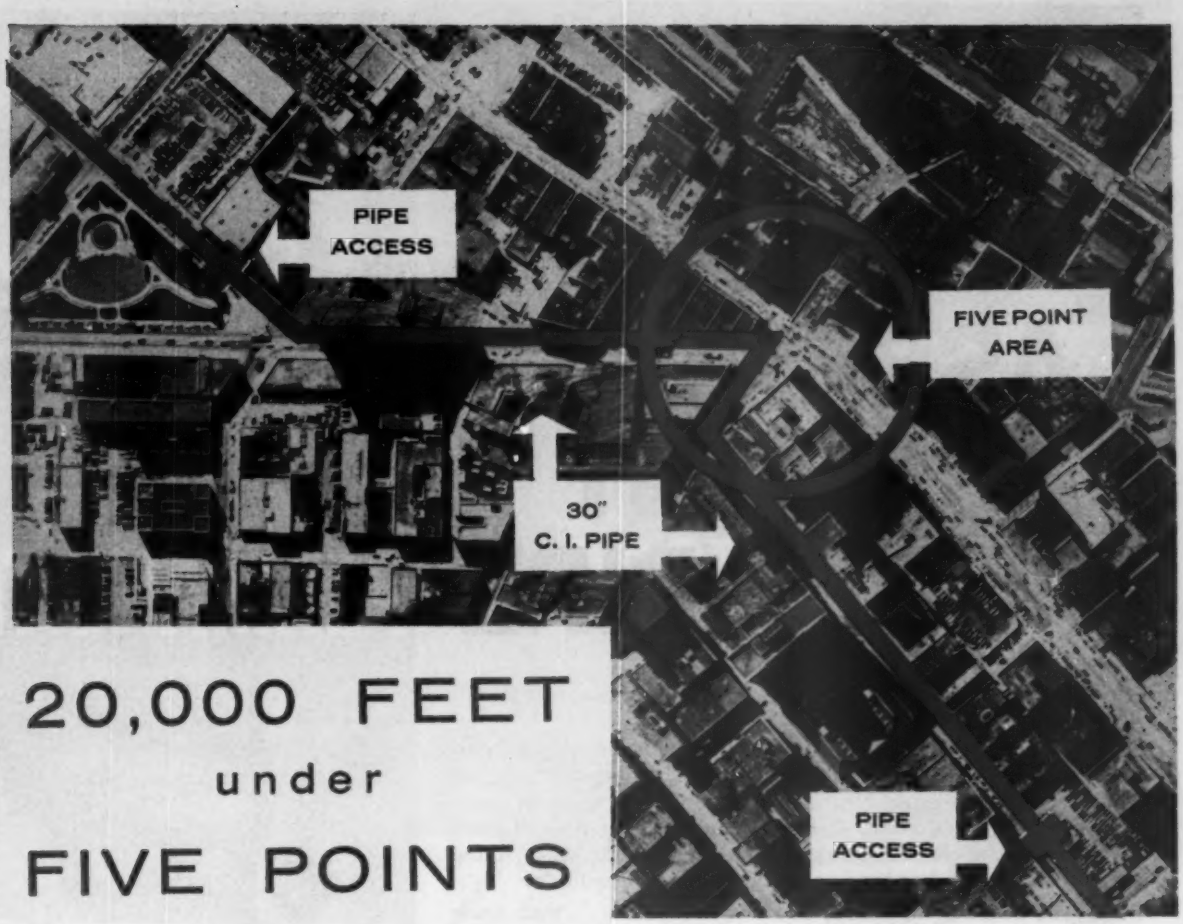
Easily Adapted to Existing Tanks

Existing tanks can be readily converted to the Rex Verti-Flo design. Better results are assured and increased capacity is guaranteed. Both cost and alterations to existing structures are minimized.

Send for Full Information

To obtain maximum capacity in any old or new plant, find out about Rex Verti-Flo Clarifiers. Write CHAIN Belt Company, 4610 W. Greenfield Avenue, Milwaukee 1, Wisconsin.

REX®
CHAIN BELT COMPANY



20,000 FEET under FIVE POINTS

You're flying over "Five Points," Atlanta's booming downtown area. Through the heart of this busy section Centriline crews have recently reconditioned almost 20,000 feet of water mains *—without slowing business or traffic.* No detours, no disgruntled merchants, and only two small access excavations in over 2,000 feet of dense traffic area, because the job was done with mains in place.

Centrilining—the process of lining pipes in place by the centrifugal application and automatic troweling of cement-mortar—offers other features, too. Gone forever are corrosion and tuberculation. Up goes pressure, at lowered pumping and maintenance costs. Pipe life is prolonged indefinitely. And all at a mere fraction of the cost and municipal inconvenience of laying new mains.

To date, Centriline has completed six contracts for the city of Atlanta alone; 150,000 feet of pipe have been given a new lease on life. Send today for our illustrated brochure, which shows in detail how the Centriline process can help you save lines from 4 to 144 inches, or contact any of our domestic offices.

CENTRILINE CORPORATION

A Subsidiary of Raymond International Inc.

140 CEDAR STREET • NEW YORK 6, N. Y.

Branch offices in principal cities of the United States, Canada, and Latin America.

K&M ASBESTOS-CEMENT SEWER PIPE

PERMANENTL

Sewer pipe maintenance headaches disappear when you install "K&M" Asbestos-Cement Sewer Pipe.

Flow-stopping, pipe-clogging roots . . . no matter how cobwebby-thin . . . can't penetrate the exclusive patented "K&M" FLUID-TITE coupling . . . unmatched in its tight sealing. In repeated tests, "K&M" Asbestos-Cement Sewer Pipe successfully resisted infiltration even when external water pressure was 25 psi . . . the equivalent of a 58-foot head and way above field conditions.

Service remains continuous and uninterrupted . . . with fewer inspections and periodic cleanings. You can reduce treatment loads and costs . . . because infiltration is eliminated. Being made of quality asbestos fibers and portland cement, "K&M" Sewer Pipe does not corrode and is immune to electrolysis.

In fact, "K&M" Asbestos-Cement Sewer Pipe is a tax-saver at every stage of construction: planning and installation, as well as maintenance. Transportation and handling is less expensive, because "K&M" Asbestos-Cement Sewer Pipe is light in weight.

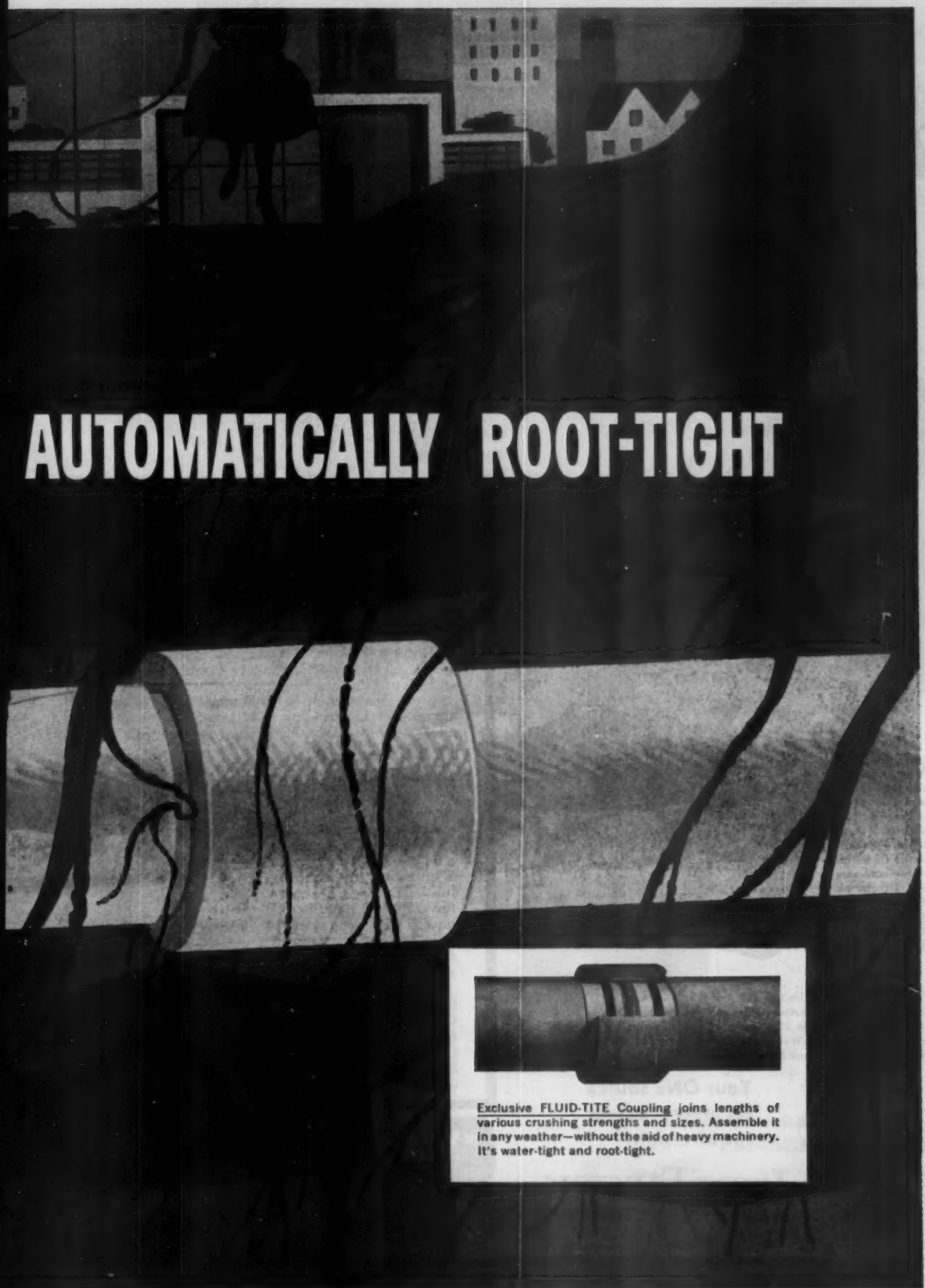
In short, practically indestructible materials plus eighty-five years of asbestos engineering give you the finest, most dependable sewer pipe available. That's why we urge you to write today for more information. Dpt. P-940.

5 CRUSHING STRENGTHS OF K & M SEWER PIPE

Size Inches	Class 1500	Class 2400	Class 3300	Class 4000	Class 5000
6	1500	2400	3300		
8	1500	2400	3300		
10	1500	2400	3300	4000	5000
12	1500	2400	3300	4000	5000
14	1500	2400	3300	4000	5000
16	1500	2400	3300	4000	5000

K·M
BEST IN ASBESTOS

KEASBEY & MATTISON
Company • Ambler • Pennsylvania

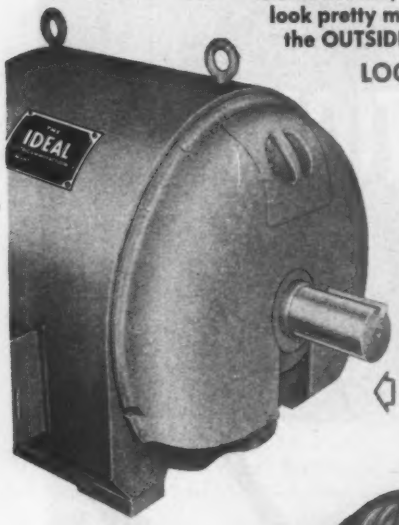


Exclusive FLUID-TITE Coupling joins lengths of various crushing strengths and sizes. Assemble it in any weather—without the aid of heavy machinery. It's water-tight and root-tight.

Quality

WHERE
QUALITY COUNTS!

GENERALLY, all motors look pretty much alike on the OUTSIDE, you say?
LOOK AGAIN!



Check the one-piece steel plate cover running the full length of the frame and extending well below the centerline on each side. That means strength and protection for internal parts.

Now, notice the cast-aluminum end shrouds with recessed access plates. Protection again—plus a big assist in maintenance and servicing. Lift the plate for oiling and inspection. Lift off the shroud for repair and overhaul.

There is a difference, isn't there? And the INSIDE story is even better. Why not write for it today? Ask for Bulletin 210 (Squirrel Cage Induction Motors), Bulletin 220 (Wound Rotor) or Bulletin 501 (High-Speed Synchronous Motors).

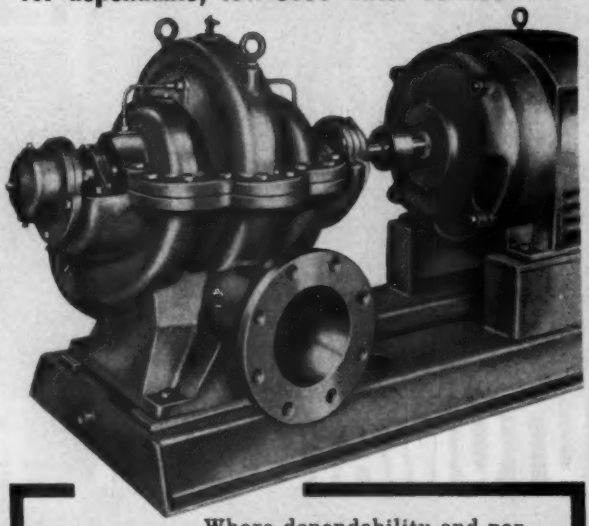
Your ONE source for every power requirement!

The IDEAL ELECTRIC & MANUFACTURING CO.
350 East First St. Mansfield, Ohio

SINCE 1903, AMERICA'S FINEST MOTORS, GENERATORS, MOTOR-GENERATOR SETS, SWITCHGEAR AND CONTROLS

WEINMAN PUMPS

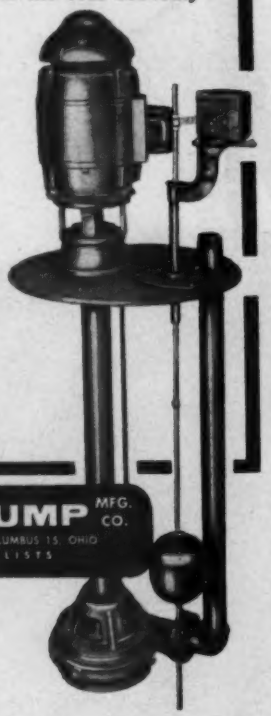
for dependable, low-cost water service...



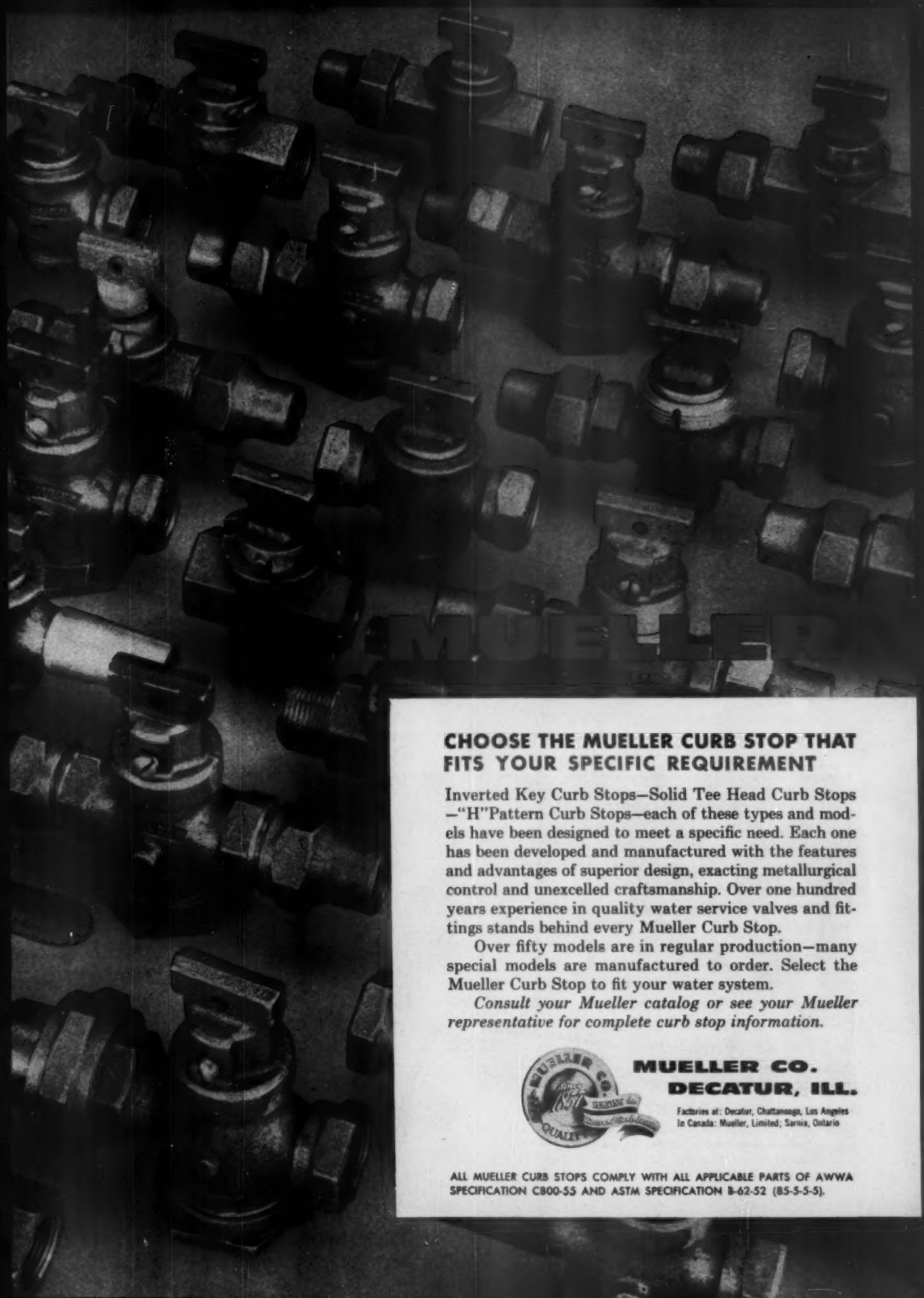
Where dependability and performance count most—at critical pumping stages of water movement—you'll find Weinman Pumps. There's good reason for it, too. Weinman Split-Case Centrifugal Pumps are precision built to function continuously at top efficiency, with little or no maintenance. The horizontally split casing speeds routine maintenance and increases the "in-service" time of Weinman Pumps. Rotating parts are quickly inspected and easily removed or replaced without disturbing connections or driver. And, the rugged construction of Weinman Pumps stands up under the grueling punishment of 'round-the-clock operation. Municipal engineers and taxpayers alike benefit from the real economy of Weinman's dependable year-in, year-out trouble-free on-line service.

And, you get the same uninterrupted, dependable service from Weinman's outstanding line of Sewage Ejectors for the swift handling of liquids of varying viscosities carrying all types of foreign matter in suspension.

Write today for full information on all Weinman Centrifugal Pumps and for the competent, on-the-job assistance of your local Weinman Specialist, check the Yellow Pages.



THE WEINMAN PUMP MFG. CO.
290 SPRUCE STREET COLUMBUS 15, OHIO
CENTRIFUGAL SPECIALISTS



CHOOSE THE MUELLER CURB STOP THAT FITS YOUR SPECIFIC REQUIREMENT

Inverted Key Curb Stops—Solid Tee Head Curb Stops —"H"Pattern Curb Stops—each of these types and models have been designed to meet a specific need. Each one has been developed and manufactured with the features and advantages of superior design, exacting metallurgical control and unexcelled craftsmanship. Over one hundred years experience in quality water service valves and fittings stands behind every Mueller Curb Stop.

Over fifty models are in regular production—many special models are manufactured to order. Select the Mueller Curb Stop to fit your water system.

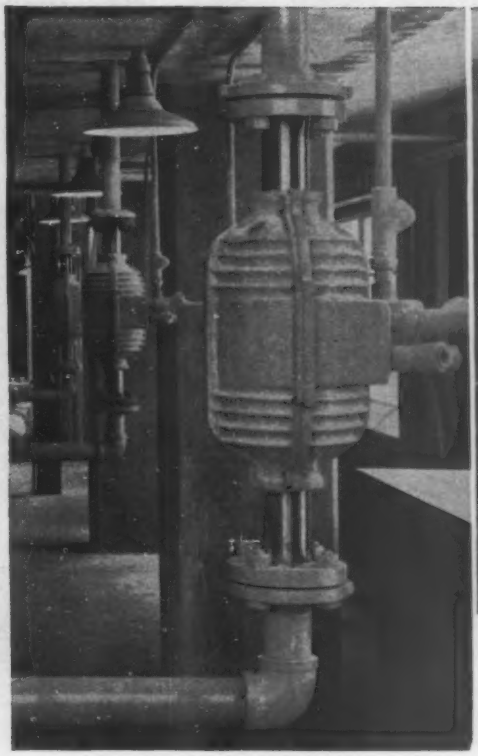
Consult your Mueller catalog or see your Mueller representative for complete curb stop information.

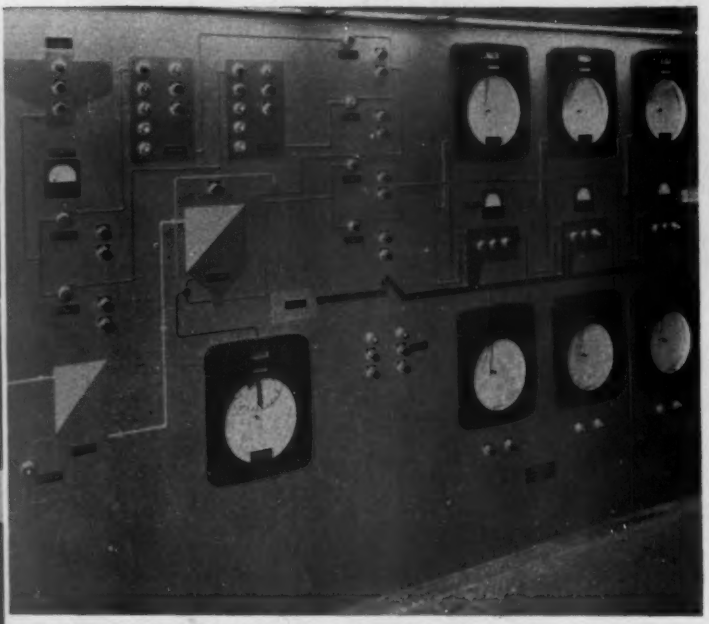
MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles
In Canada: Mueller, Limited; Sarnia, Ontario

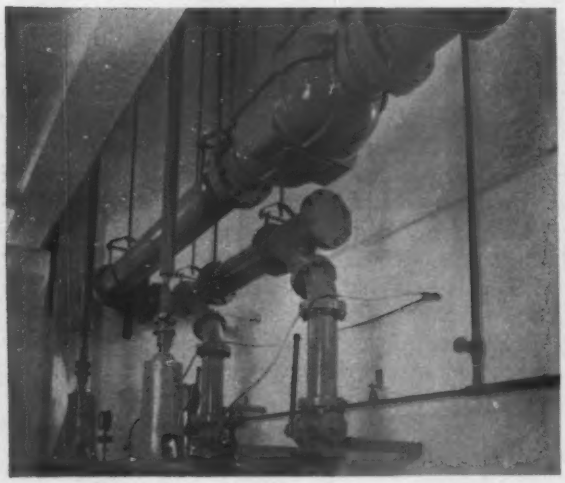
ALL MUELLER CURB STOPS COMPLY WITH ALL APPLICABLE PARTS OF AWWA SPECIFICATION C800-55 AND ASTM SPECIFICATION B-62-52 (85-5-5-5).

Foxboro Magnetic Flow problems for





DAYTON, OHIO Three Foxboro Magnetic Flow Meters measure flow of sludge to centrifuges at Dayton's Lime Recalcining Plant. Designed around these meters, plant actually recovers up to 20% more lime than originally added to water. Graphic control panel in Feed End Building operates entire plant.



NEWPORT, R. I. At Newport, R. I. influent at the main sewage plant comes from both the town and a nearby Navy base. Determining how much of the total should be billed to the Navy is the job of the Foxboro Magnetic Meter and Foxboro Dynalog Recorder shown above.

Meters eliminate line restriction these municipal utilities

Introduced six years ago, the Foxboro Magnetic Flow Meter has proved its superiority for measuring water, sewage, sludge and other treatment plant flows.

Foxboro Magnetic Flow Meters have no flow restrictions of any type. No taps to get plugged or frozen, no seals or purges, no moving parts of any type. Measurement is made by electrodes flush-mounted in meter wall — then transmitted by electric cable to a Foxboro Dynalog* electronic recorder. Accuracy is ±1%.

Foxboro Magnetic Flow Meters have solved some of the toughest municipal measurement problems. Ask your Foxboro field engineer to show how it can help with yours. Or write for Bulletin 20-14. The Foxboro Company, 894 Neponset Avenue, Foxboro, Massachusetts.

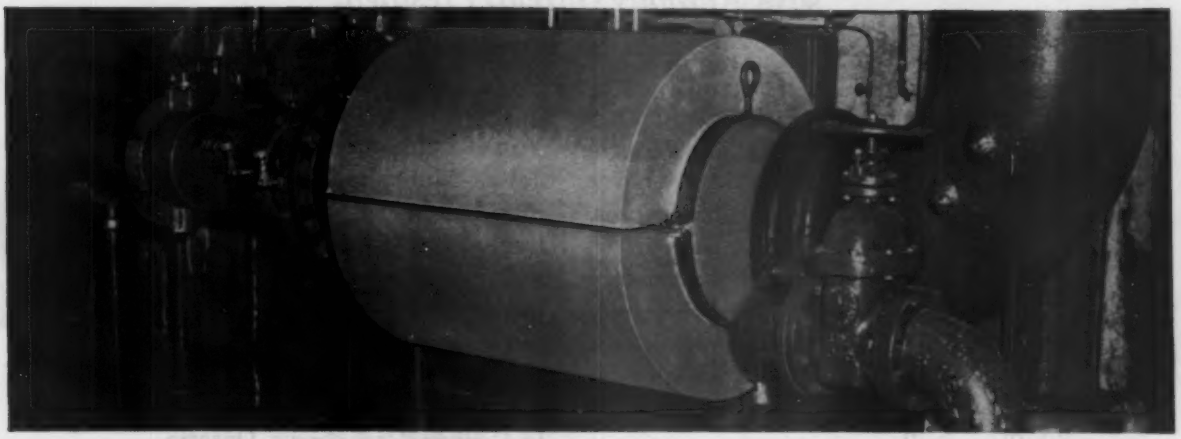
Reg. U. S. Pat. Off.

Partial List of Progressive Communities Using Foxboro Magnetic Flow Meters

Benton Harbor, Michigan	— raw sewage
Hayward, Calif.	— water
Pittsburgh, Pa. (Allegheny County Sanitary Authority)	— raw sewage
Covington, Ohio	— return activated sludge
Medfield, Mass.	— water
Orange County, Calif.	— sewage
Warren Township, Michigan	— raw sewage and sludge
Bloomfield Township, Michigan	— water
Seattle, Washington (Lake City Sewage Plant)	— sludge
Milwaukee, Wisconsin	— sludge
Piqua, Ohio	— sludge
Arkansas City, Kansas	— sewage
Sidney, Ohio	— return activated sludge
Frazer, Michigan	— raw sewage

Meter sizes on these installations range from 3 inches to 6 feet.

FARMERS BRANCH, TEXAS Eight-inch Magnetic Flow Meter at a sewage lift station. Meter was installed below ground level, right next to elbow and valve, without affecting its measurement accuracy.



CHICAGO, ILLINOIS This 20" Foxboro Magnetic Flow Meter was installed in the South District Filtration Plant in April, 1956. Because it has no line restrictions, plant officials knew the meter would add no more pressure drop than an equivalent length of pipe. Note how it was installed directly downstream from an elbow.

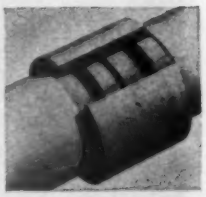
FOXBORO

REG. U.S. PAT. OFF.

"Not a 'comeback' in 18 years" ...with Transite Sewer Pipe

says Anthony Garcia, President
Allerton Construction Co., New York

"In my eighteen years of installing Transite sewer mains and house laterals, I have never had a 'comeback' because of line failures. Most of the installations have been 100% under water. Therefore, tight joints that stay tight are absolutely essential! For these reasons Transite has always been my choice for sewer line service. I never worry about passing leakage or infiltration tests. I play it safe —with Transite."



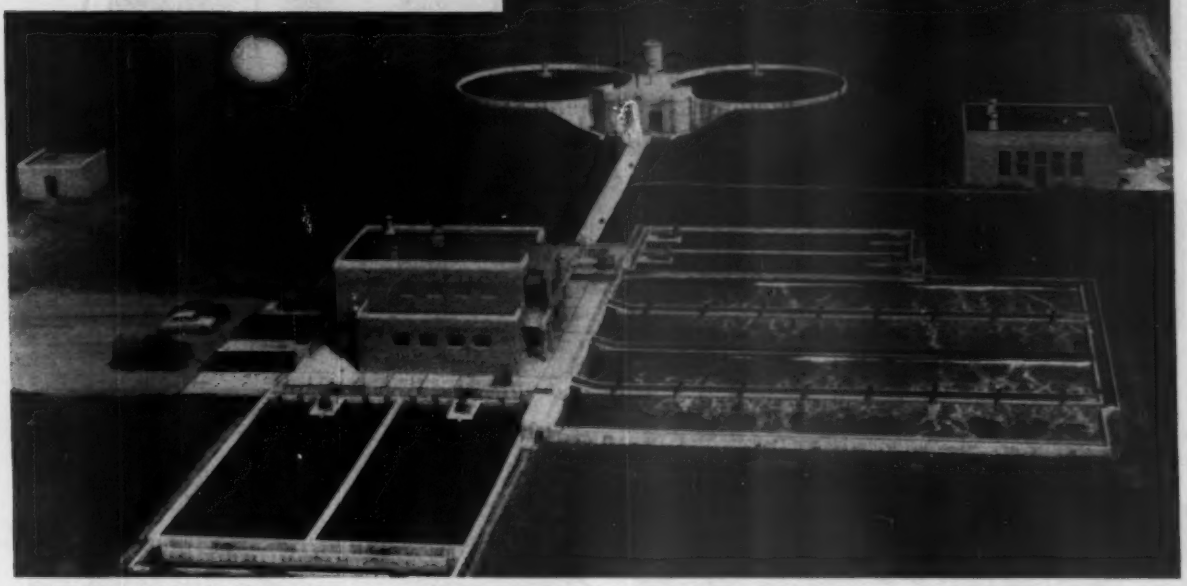
You'll want to read how Johns-Manville Transite® Pipe has helped other contractors increase their profits and productivity . . . in the informative and interesting new, 8-page booklet, TR-206A. Send for it now! Address Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE

JOHNS-MANVILLE JM PRODUCTS

P.F.T.

DUAL DIGESTION



Modern Sewage Treatment at Connersville.

Embodying the following features, the Connersville, Indiana Sewage Treatment plant is serving the community efficiently and economically—

P.F.T. Dual Digestion. Not only do the two 65′ P.F.T. Floating Cover Digesters receive the normal domestic wastes, but in addition, they receive garbage collected weekly from residential areas. This highly volatile waste, after a grinding process, is pumped directly to the P.F.T. digesters.

Compactness. The Control Building is located in the center of the aeration and settling tanks and simplifies the control of plant operations. Expansion of the plant will be possible without disrupting operation because of this structural arrangement.

Equipment. Besides the two 65′ P.F.T. Floating Covers, Connersville also has a #750 P.F.T. Heater and Heat Exchanger Unit, and P.F.T. Gas Safety Equipment.

Engineering. Garns and Moore and Associates, Inc., Indianapolis were the Consulting Engineers.

P.F.T.

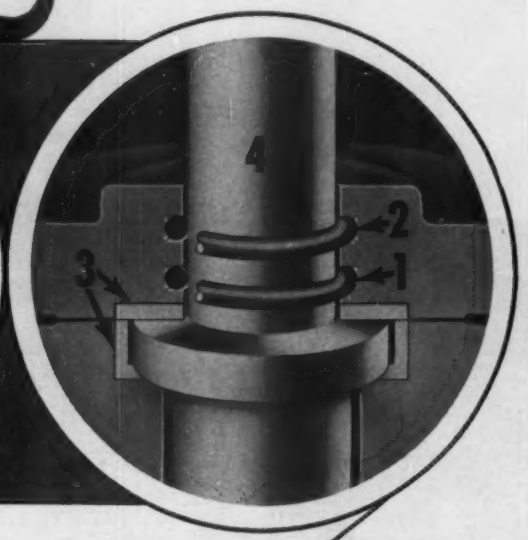
waste treatment equipment exclusively since 1893

PACIFIC FLUSH TANK CO.

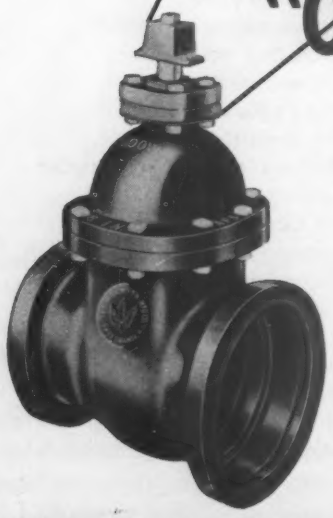
4241 RAVENSWOOD AVENUE, CHICAGO 13, ILLINOIS

PORT CHESTER, N.Y. • SAN MATEO, CALIF. • CHARLOTTE, N.C. • JACKSONVILLE • DENVER

DOUBLE SEALING



SMITH VALVES WITH "O" RING SEALS



"O" Rings, due to their simplicity and reliability have been used for many years in military and industrial products. Smith non-rising stem valves are available with *double* "O" Ring seals. The lower "O" Ring (1) seals the internal pressure, while the upper "O" Ring (2) is a combined external dirt and reserve pressure seal. This construction eliminates packing, gland adjustment, and conventional stuffing box. All Smith AWWA specification valves are equipped with stem (thrust) collar bushings (3) and extra large, high strength bronze stems (4). These and other well known Smith superior design features assure positive operation, long service life, and minimum maintenance.

60

FIRE HYDRANTS · VALVES · SINCE 1896

THE A.P. SMITH MFG. CO.

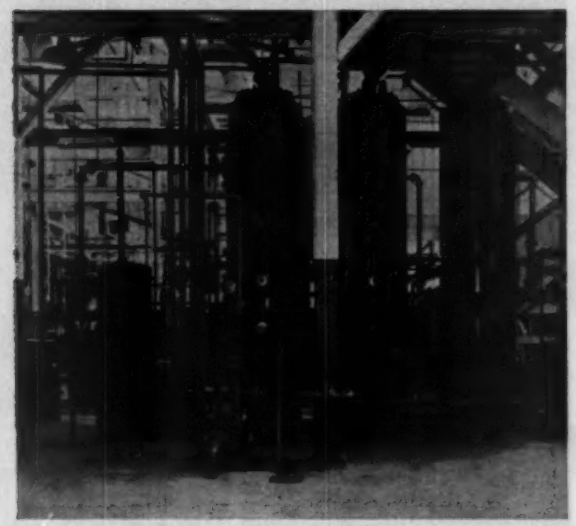
EAST ORANGE, NEW JERSEY

FLUIDICS

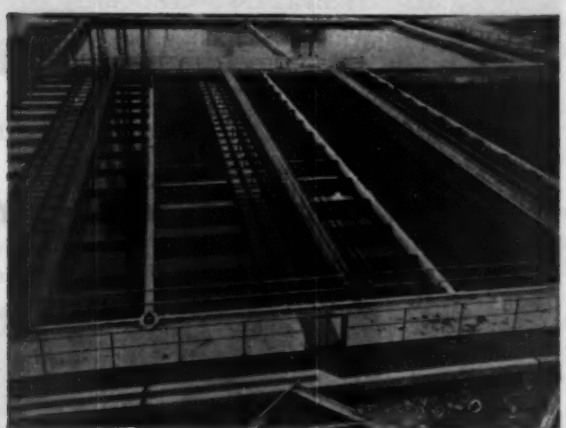
is a Pfaudler Permutit program providing

the know-how
the equipment
and the experience
for solving problems involving fluids

FOR WASTE TREATMENT, the Fluidics program provides a wide range of specialized equipment and technical service to help you efficiently recover valuable materials and easily dispose of unwanted wastes.



Purification of liquids and recovery of dissolved minerals from plating solutions, pickling baths, textile wastes, process solutions and similar fluids are assured with unique effectiveness by Permutit Ion Exchangers. Recovery of valuable materials often pays for equipment within a short time.



Sludge blanket clarification of fluids requiring removal of suspended solids such as fly ash, precipitates, turbidity, etc. is accomplished with high efficiency by the Permutit Precipitator.

Dewatering Sludges. Titan Centrifuge exerts settling power up to 7800 times gravity. Concentrates slimes and clarifies liquids. Precisely separates two liquids and a solid in a single pass. Dewaters plating wastes, protein fines and flocculent precipitates. Recovers oil from tank bottoms, fat from waste, and pulp from white water. Saves product, filter aid, power and maintenance.

Flotation clarification of fluids containing fats, oils, greases, organics and colloidal suspensions is done quickly, effectively and economically with the Permutit Colloidair Separator.

Add to this equipment our Simplex meters and flow controllers, Permutit chemical feeders, filters and vacuum degasifiers, Ranarex CO_2 indicators and recorders, and Pfaudler evaporator systems, and you get an idea of the scope of this program in just the waste treatment area of fluid processing. Yet Fluidics is a program that provides more than just equipment. You can get complete engineering assistance as well as expert advice based upon more than 50 years' experience in fluid waste control.

For more information on how Fluidics can help in your waste treatment program, contact our Permutit Division, 50 West 44th Street, New York 36, N. Y.

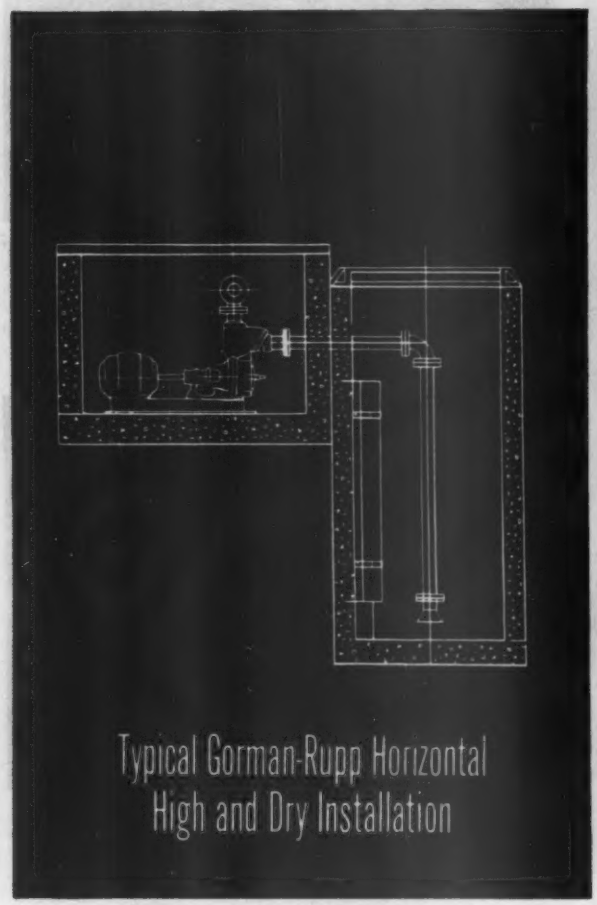
In Canada: 207 Queen's Quay W., Toronto 1, Ontario.

PFAUDLER PERMUTIT INC.

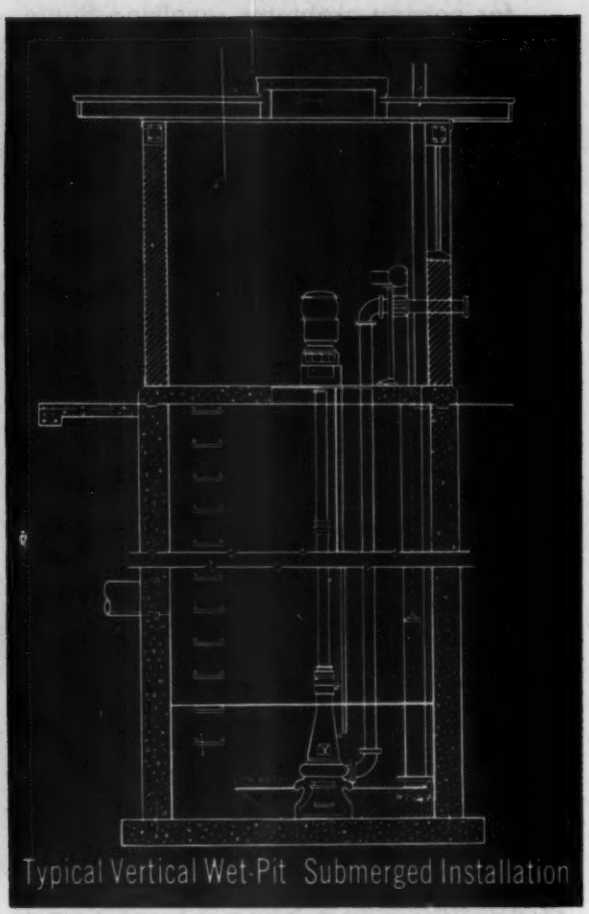
Specialists in FLUIDICS...the science of fluid processes

SAVE UP TO 50%...

GORMAN-RUPP Sewage Pumps



Typical Gorman-Rupp Horizontal High and Dry Installation



Typical Vertical Wet-Pit Submerged Installation

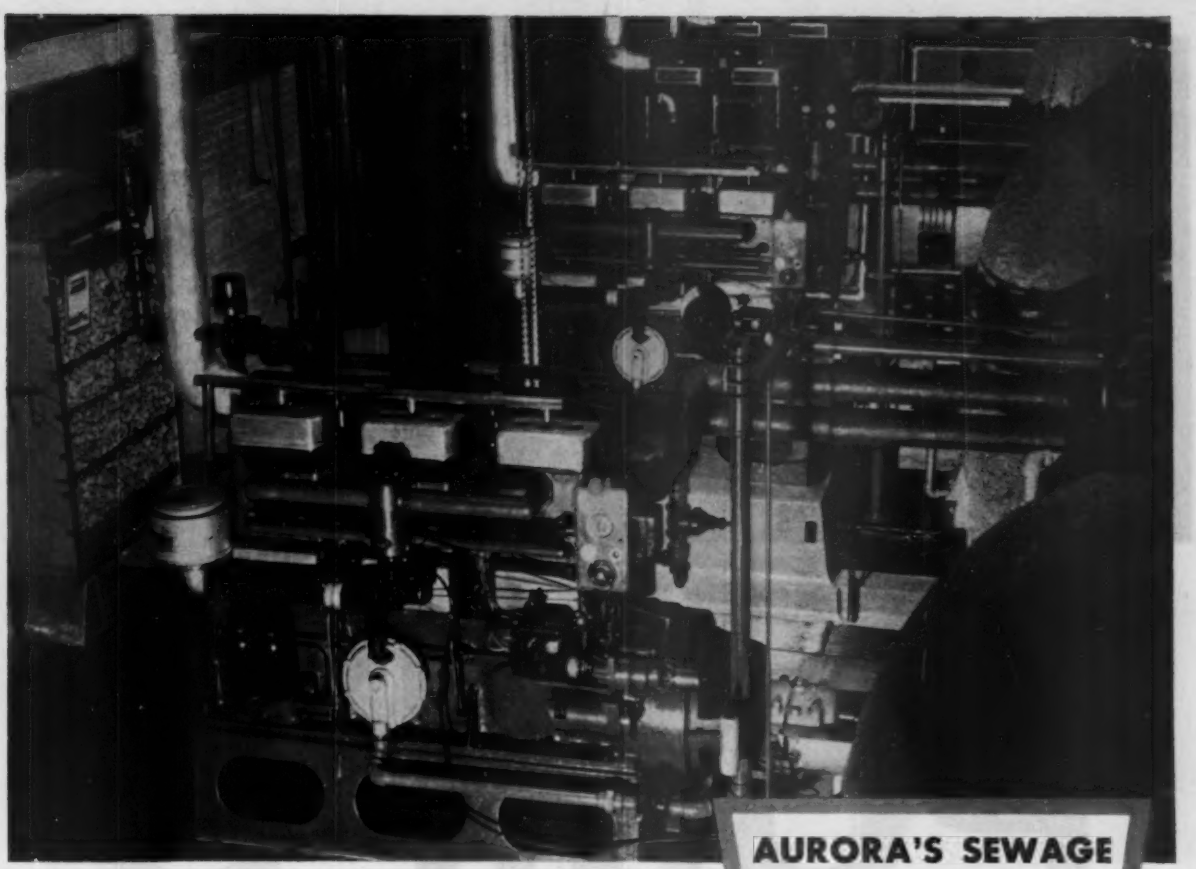
A glance at the two diagrams above will quickly show simplicity of installation. Further study of equipment costs will add to the proof of savings when you install Gorman-Rupp High-and-Dry Sewage Pumps. These economies are possible through design features which permit self-priming in lifts up to 15 feet, positive action, and nearly complete avoidance of clogging.

Gorman-Rupp Sewage Pumps need almost no maintenance compared to submerged pumps. No need to service by entering pit or raising pump. Just a turn of the handle and the end plate is off.

In lift stations and sewage plants, these Gorman-Rupp units have shown amazing savings . . . operating where others have failed. 2", 3", 4" and 6" pumps —connected to your power or ordered complete with power units. Write for specifications.

THE GORMAN-RUPP COMPANY
305 Bowman Street Mansfield, Ohio
Gorman-Rupp of Canada, Ltd., St. Thomas, Ontario

In Jacksonville, Florida, a 3-inch Gorman-Rupp Pump replaced a submerged pump after 2½ years in service.



for over 22 years

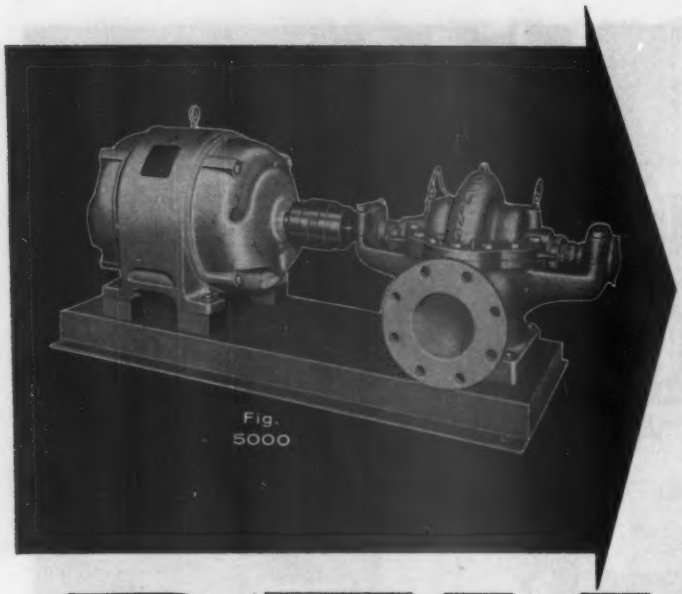
AURORA'S SEWAGE TREATMENT PLANT has been POWERED by these

CLIMAX ENGINES

The Aurora Sanitary District, Aurora, Ill., installed two 75 hp, six-cylinder Climax pump engines in 1936. These direct-connected engines performed so well—always starting under load—that, in 1940 two 50 hp Climax engines in generator sets were added. All four engines had sewage gas and gasoline carburetors. In 1953, gasoline was replaced by natural gas as standby fuel. This gave the plant four-way safety—duplicate engines . . . two fuels . . . two ways to start generator engines . . . freedom from electric storm interruption. After 22 years, 8 months, pump engines had paid for themselves 4.78 times; generator engines 2.5 times after 17 years. Year after year Climax engines keep on making records like this. 40 to 610 hp; V-type—four models, 8 and 12 cylinder; in-line type—four models, 4 and 6 cylinder. Capable of operation on sewage gas, natural gas, butane, gasoline, or any combination. Send for complete power chart and bulletins.

CL-104

CLIMAX ENGINE MANUFACTURING CO.
DIVISION OF WAUKESHA MOTOR COMPANY
FACTORY AT CLINTON, IOWA



SPLIT-CASE CENTRIFUGAL

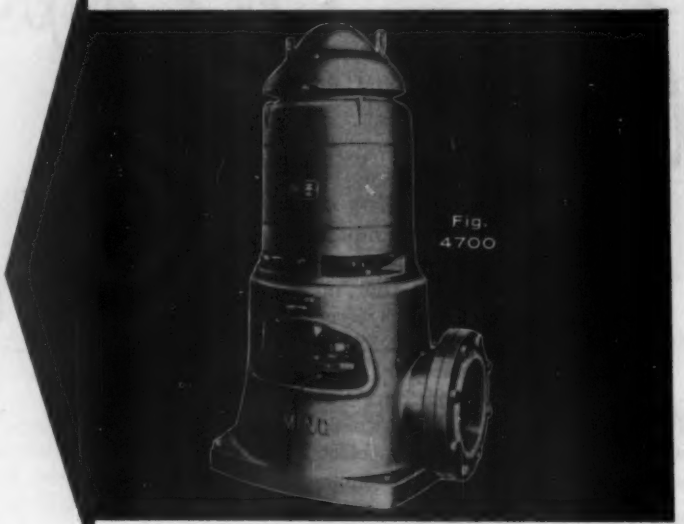
Provide peak performance for heavy, continuous pumping of clear water. The Deming Split-Case Centrifugal is a rugged unit with all rotary elements in perfect balance, both statically and dynamically, assuring vibrationless operation. A full range of sizes from 2" to 14".

DEMING PUMPS

FOR EFFICIENT WATER WORKS SERVICE

VERTICAL TURBINE

Dependable, economical. Designed and manufactured to meet discriminating Water Works installation standards. Deming Vertical Turbines are available with any type of power in a wide range of capacities to meet your specific requirements.

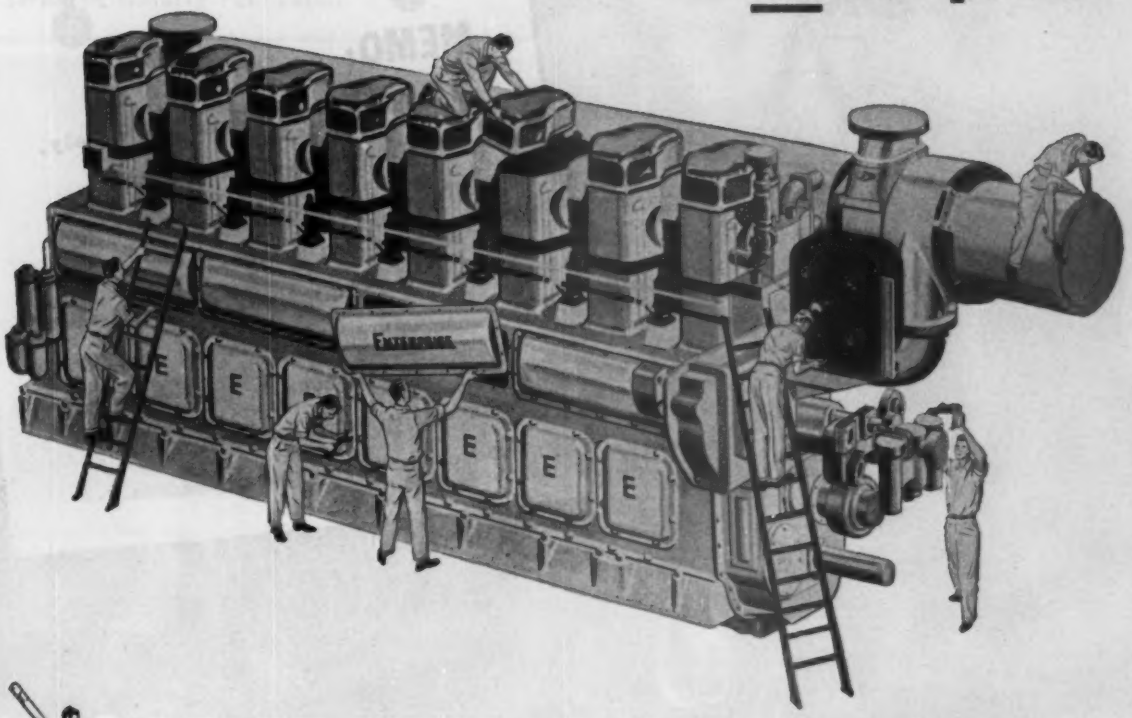


Ask for a recommendation on your next project

The DEMING Co.

488 BROADWAY • SALEM, OHIO

It's easy to get to all the parts



Check these points
on "Easy-Access" ENTERPRISE Design
All major moving parts are enclosed with removable covers:
Main and connecting rod bearings are fully accessible through large door plates on both sides.
Cams, followers, camshafts and bearings are easily reached and removed.
Cylinder head and rocker arm assemblies, push rods and fuel nozzles are easy to reach by removing oil and dust-proof covers.
Gears are accessible through easily removable inspection covers.
No bulky shrouds or surplus covers to remove before getting to engine.
Parts, accessories and controls requiring occasional inspection or servicing are externally mounted.

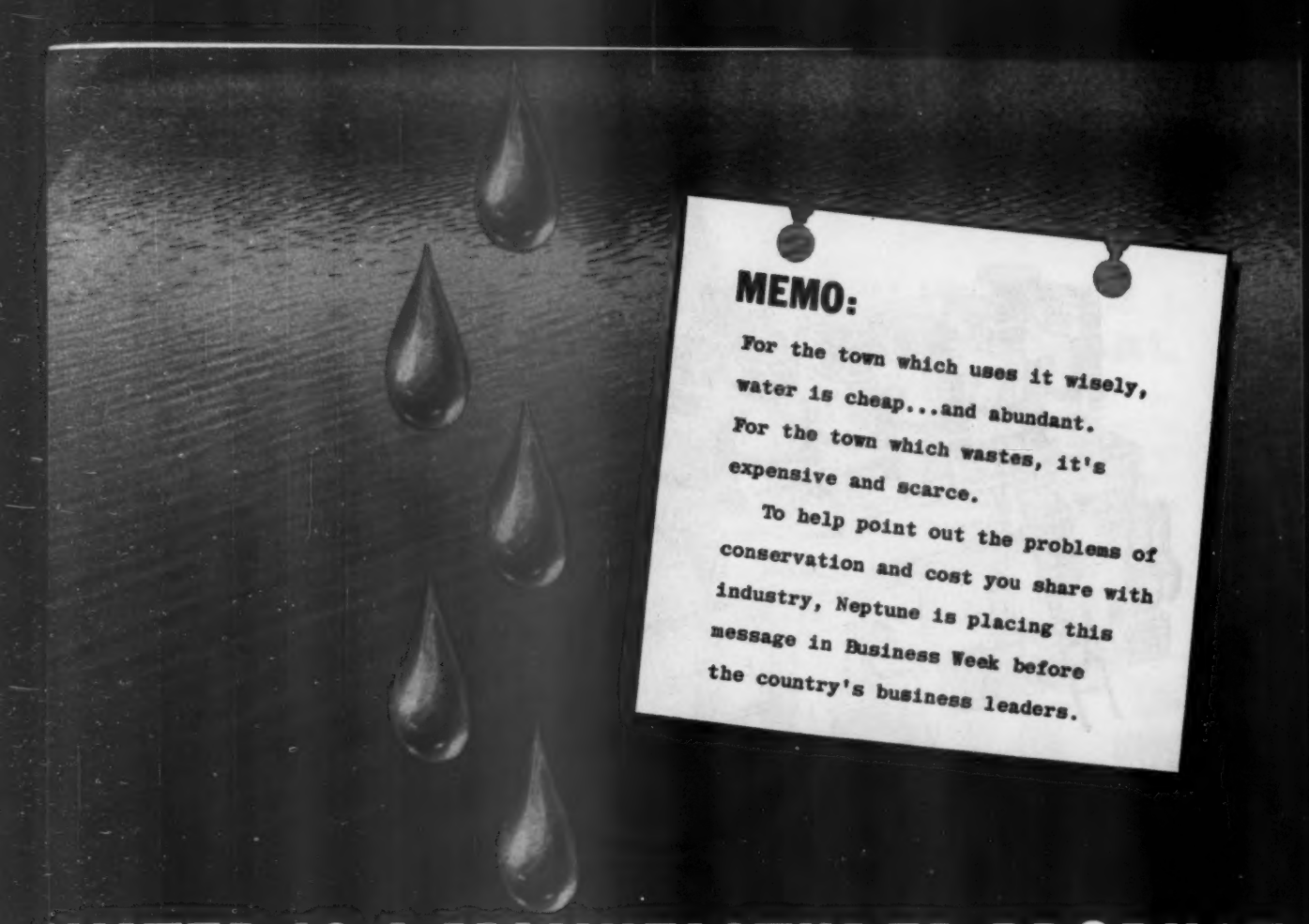
You'll find that ENTERPRISE accessibility saves time, money and manpower in maintenance and overhaul

Ever watch precious hours slip by trying to find a way to dismantle, inspect or replace an engine part or assembly? Such unnecessary and costly down-time is something you don't have to worry about with modern, "easy-access" ENTERPRISE Diesels. For ENTERPRISE service-wise engineers have designed every model in the entire 73 to 2284 HP line for maximum accessibility and easy, low-cost servicing. That's why we say – and mean – you'll have less down-time if it's powered by an ENTERPRISE Dependable Diesel!

ENTERPRISE *Diesels*

THE DEPENDABLE

Enterprise Engine & Machinery Co., Subsidiary of General Metals Corporation
18th & Florida Streets, San Francisco 10, Calif. • National and worldwide sales and service.


MEMO:
For the town which uses it wisely, water is cheap...and abundant. For the town which wastes, it's expensive and scarce.
To help point out the problems of conservation and cost you share with industry, Neptune is placing this message in Business Week before the country's business leaders.

WATER IS A MANUFACTURED PRODUCT

...too expensive to waste

Here's what Ansco Mfg. Co. gets out of a gallon of water (with the help of Neptune meters)

1. Well water at 53° used first for air conditioning
2. Chlorinated, used for spray washing
3. Used in chemical dehumidifier
4. Passes through heat exchanger
5. Passes through ammonia condenser
6. Goes to fire protection reservoir
7. Finally used to cool roof

Water in the lakes and rivers is free, but there it's only a *raw* material.

Before you can use it, you put it through a complete chemical manufacturing process. You need expensive equipment and chemicals to collect it, store it, pipe it and purify it. By that time water is much too expensive to waste.

But how do you keep your people from wasting it?

Install water meters at every key point in your plant. Measure what every department or process uses. Ask the meters to uncover hidden leaks and careless habits. They show where you can save with automatic shut-off devices, by improving heat exchangers, by altering processes, by recirculating and reconditioning water for re-use. Don't dump a drop down the drain until you've gotten full use out of it.

Call Neptune for help in saving water costs. Though Neptune now means more than just meters, water conservation—through accurate metering—is still our biggest business.

neptune
for a better measure of profit

NEPTUNE METER COMPANY
19 West 50th Street • New York 20, N. Y.
In Canada: Neptune Meters Ltd., Toronto, Ontario

LIQUID METERS
GAS METERS
ELECTRONIC SYSTEMS and COMPONENTS for MEASUREMENT and CONTROL

Vol. 107, No. 4 • April, 1960

A Scranton Gillette Publication

WATER & SEWAGE WORKS

Expanding population and water needs lead Clinton, S. C. to build this . . .

New 3 MGD Water Filtration Plant

RESUME: The first water supply for Clinton, S. C. was a combined steam generating and water pumping station. Since 1906 when this plant was put into service the town has grown steadily. By 1924 the original ground water source had to be replaced by a surface supply and the first filtration plant was built. In 1958 this supply was also inadequate. It was necessary to go some nine miles to supplement the existing source as well as to construct a new expanded filtration plant. Water is now taken from the Enoree river and pumped to a raw water reservoir. From raw water storage flow is by gravity to the filtration plant with the rate controlled automatically by the level of the water in the flume entering the plant. The water is then coagulated, settled, filtered and chlorinated. Among the interesting features of the installation are the inlets and outlets of the settling tanks, the flexibility designed into the plant and the use of considerable instrumentation.

by GEORGE W. WHITE, Pres.
The Horwood Beebe Co.
Spartanburg, S. C.

■ THE TOWN OF CLINTON is located in the lower Piedmont Section of South Carolina, between the watersheds of Little River on the south and Duncan Creek on the north. Beyond Duncan Creek is Enoree River, to which the Creek is tributary. Enoree River is the largest of these streams.

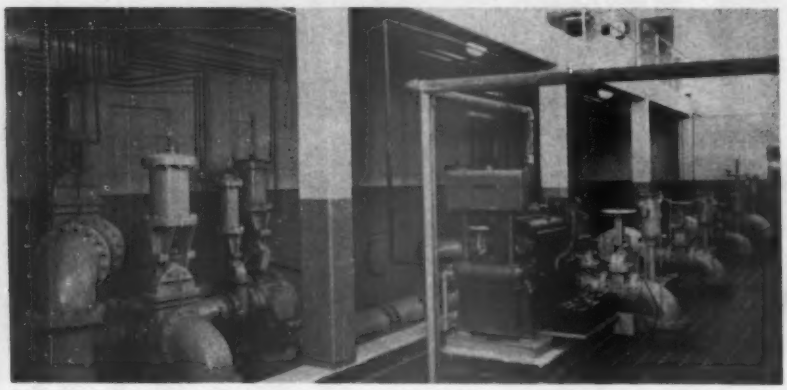
The population of Clinton in 1950 was 7168, having more than doubled in 40 years. A population of 10,000 is expected by 1975.

History

Clinton's original water works plant was a combination steam-electric generating plant and pumping station, constructed in 1906. It provided the town with electric lights and power, and with water. The water came from deep wells and was pumped to a 100,000-gallon reservoir, and thence to a 75,000-gallon elevated steel tank on the site, and to the distribution system.

In 1924, a filter plant of 1.0 mgd capacity was constructed on the same site and the reservoir increased to 250,000 gallon capacity. Raw water was taken from Beard's Fork of Duncan Creek and pumped through a 10-in. main to the plant. This arrangement served about ten years, at which time the demand exceeded the supply.

THE FILTERS are located outside with the operating floor and pipe gallery running along the back of the plant building



THE PIPE GALLERY and pump room with the operating floor above

The 10 in. main was then extended to Duncan Creek, a new raw water station was constructed there, and new pumps were installed. The filter plant was renovated and improved at the same time. In the meantime, the power plant had been abandoned and power purchased from Duke Power Company for local distribution. In 1950, major additions were made to the distribution system, and a 250,000 gallon elevated steel tank was erected.

By 1954, it became apparent that further improvements and enlargements to the works would soon be needed to adequately supply the town with water. A careful study was made of the situation and it was determined to construct an intake on Enoree River, 9.5 miles away, with a 14 in. force main to town, and a new 2 mgd filtration plant. In 1958, plans were prepared and construction was begun.

New System

The plans provided for the general arrangement previously decided on, but with some changes which seemed warranted by current conditions. Additional growth and anticipated expansion indicated the need of a 16-in. raw water main, and a 3 mgd plant. These were embodied in the plans, along with further improvements to the distribution system.

The pumping station constructed on the bank of Enoree River consisted of intake works, and a wet well for the pumps, enclosed in a brick superstructure. The intake was provided with trash racks on the river side and fine screens of ¼ inch mesh, 12 gauge aluminum wire mounted on aluminum frames ahead of the pump pit. These screens are removable to facilitate cleaning. The intake is separated from the pump pit by a concrete wall, in which is a 24 in. sluice gate.

Space was provided for three pumps, but only two were installed. They have capacities of 2 mgd each against a total head of 340 ft, and are designed to pump 3 mgd when operating together. They are vertical turbine units, driven by 440 volt, 125 HP, squirrel cage motors, with reduced voltage starters. In addition to this supply 1 mgd can be obtained from Duncan Creek.

To protect the pumps and main against water hammer, an automatic check valve was installed in their discharges. These valves open slowly after the pumps are up to speed, and close slowly before the pumps stop. A surge relief valve was also installed on the discharge main as a precaution against the surge which could be caused by power failure.

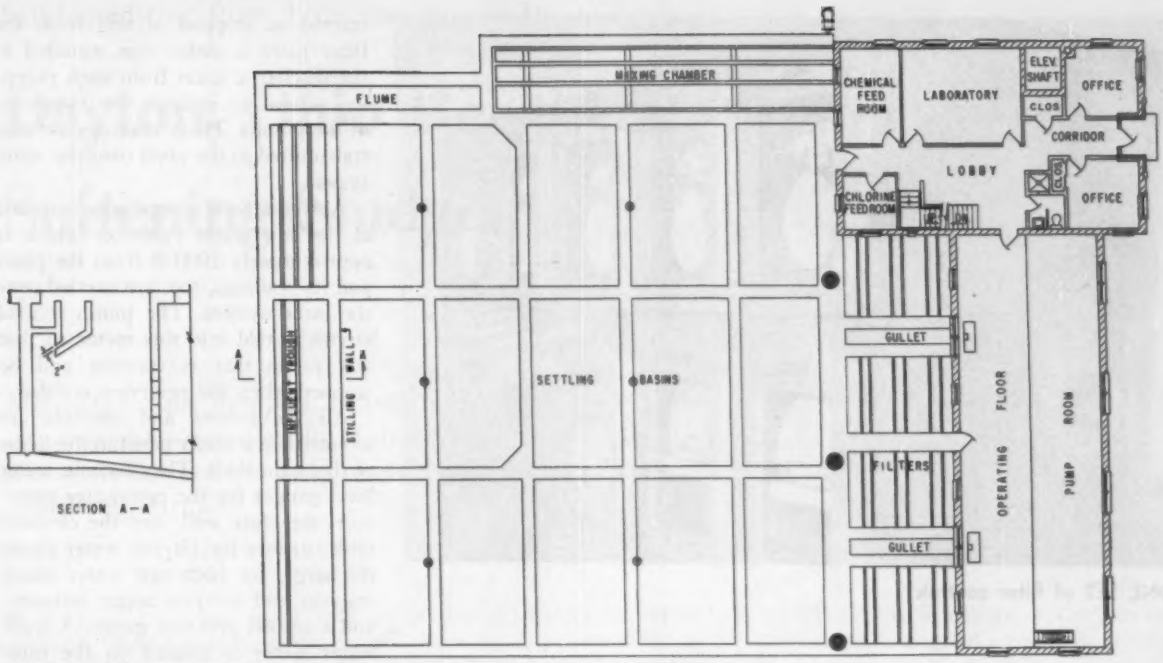
The raw water main is a 16 in. cast iron pipeline, 9.5 miles long. At the Duncan Creek pump station the two mains are connected and finally discharge into the original raw water reservoir. From there the water flows by gravity through a 20 in. main to the filter plant.

A particularly difficult portion of the work was at the crossing of S.C. highway 308. After the 16 in. main was located paralleling the old 10 in. main, the highway department started construction of new US 276, crossing old 308, at the point where the 10-in. main crosses. Plans called for US 276 to go under 308, with a bridge and interchange roads to be constructed, involving deep cuts and high fills. To avoid going under the cuts and having a high fill constructed over the main, the 16 in. main was relocated around the interchange. However, the highway department decided to take up the 10 in. main during construction of the roads. It was then relaid under the cut for US 276, and in the fill of the interchange road after it was compacted. The cost of these changes was borne by the highway department.

Filtration Plant

The first unit of the filtration plant is a mixing chamber of 30 min detention period, equipped with over-and-under baffle. The chamber is so arranged that it can be extended to provide for future enlargement of the plant. Coagulated water is conducted to the head of the settling basins in a concrete flume which is divided into three at the entrance to the basins, which provide a six hour detention period.

One-third of the water passes through a longitudinal slot in the bottom of the flume, into the first basin. The remainder passes through the first basin and by a similar arrangement into the second and third basins, as



OPERATING FLOW DIAGRAM for the Clinton plant

shown in diagram. This arrangement has been found very effective in securing good sedimentation of the floc. A stilling wall in each basin contributes to uniform distribution of flow over the cross-section of the basin.

Uniform flow is further induced by specially designed effluent weirs. Instead of the conventional overflow type, the weir is submerged, and consists of a series of 2 in. orifices 8 in. below normal water level. The orifices are so sized and spaced as to create a differential head of about 2 in. between water in the basin and that in the effluent gullet.

From the gullet, the water passes through mud valves into a cast iron pipe manifold, from which it is drawn into either or both of two filters. This arrangement makes the plant very flexible. Filters have a capacity of 1.5 mgd each, and are divided for washing. They are equipped with Wheeler bottoms, and are rated at 2 gal per sq ft per min. The filters are operated hydraulically from control tables located on the operating floor which is a platform over the pipe gallery. They are washed by a pump controlled by a push button conveniently located on this floor. Wash rate is 15 gal per sq ft per min or a 24 in. rise in the filter. The pump is overcapacity and can supply enough water for washing at a higher rate.

The filtered water pump room is located in front of the pipe gallery and is equipped with the wash water pump, two service pumps of 540 gpm and 1400 gpm, respectively, all motor driven, and a 2100 gpm emergency pump driven by a gasoline engine. The pumps are horizontal, centrifugals, and are primed by a vacuum system which is automatic in operation, and prevents motor driven pumps from starting unless they are primed. One pump is controlled by water level in the elevated tank while the others are manually controlled. All motor driven pumps have reduced voltage compensators.

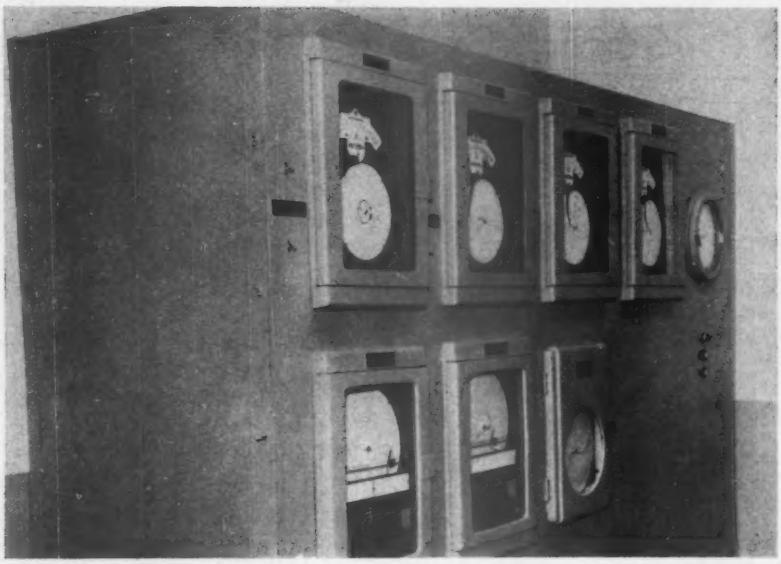
From the filters, water flows to a 750,000 gal clear well, 112 ft in diameter and 10 ft deep. This shallow depth was decided on because a very soft, water-bearing material had been found by borings to underlie the plant site at a depth of 15 to 18 ft. Above this was a sand-clay formation that was suitable for foundations. This also indicated the use of horizontal pumps instead of constructing a deep suction main into the building for vertical units. The reservoir has a suction (or effluent) well on the side near the plant so connected that water may be filtered into it and pumped from it while the reservoir is dewatered for cleaning or repairs. Normally, water is discharged directly into the reservoir. Circulation of water is assured by a concrete block wall constructed across three-fourths of the diameter of the reservoir between the influent point and the suction wall.

Controls and Meters

The control section of the building contains offices, chemical laboratory, dry chemical feed room, chlorinator room, and lobby on the main floor. Chlorine storage and general storage rooms, furnace room, and utility area are on the ground floor accessible by trucks. Chemical storage is on the third floor, so that the dry feed machines may be charged from above. An elevator which can be loaded directly from trucks is provided for moving chemicals to the storage area.

Chemical and chlorine feed rooms are located near the head of the mixing chamber. Equipment has been provided for alum and lime prefeed, and soda ash post feed. Space is provided for a fourth feeder. Two chlorinators are also provided, arranged for either pre and post chlorination. All machines are manually controlled.

As the raw water comes to the plant by gravity, it was necessary to provide control which would prevent overflow of the basins. For this purpose, a pneumatic controller was installed powered by an air compressor installed on the ground floor. A bub-



ONE SET of filter controls

bler sensing element in the flume from the mixing chamber operates via a control unit to a butterfly valve in the raw water influent, opening or closing the valve to provide the desired rate of flow. The equipment is quite satisfactory and controls water level within an inch, regardless of the rate of filtration.

For control of the raw water pumps an electronic, or "telemetering", system was installed. This permitted all control impulses to be carried over one pair of wires which is a real economy considering the 9.5 miles involved. Since any pump may be started or stopped at will from the filter plant a meter was installed in the discharge main from each pumping station to indicate the operation of the pumps. These readings are also transmitted to the plant over the same system.

A water level gauge was installed at the raw water reservoir which is approximately 1000 ft from the plant and its readings, too, are carried over the same system. The pump control circuit is tied into this meter so that any pump that is running will be stopped when the reservoir is filled.

All the meters and controls are mounted on a meter panel in the lobby of the main floor. They include water level gauges for the raw water reservoir, the clear well, and the elevated tank; meters for filtered water pump discharge, for both raw water pump stations and for raw water influent; and a system pressure gauge. A wash water meter is located on the filter operating floor, and a filtered water meter and pressure gauge are on the pump room floor.

The distribution system was also improved by construction of a 16-in. main to the larger elevated tank, a 12 in. belt line around town, and some service mains.

An Inexpensive Way To Eliminate Rusty Tap Water

Rusty, red tap water can be eliminated cheaply, according to Dr. Robert F. McCauley, professor of civil engineering at Michigan State University. Dr. McCauley has devised a method in which a city can put a rust-preventive coating on the inside of iron pipe in its water distribution system.

"Although most new water systems use iron pipes coated with cement to prevent rust," he said "there are thousands of other systems in which rust form readily and creates major problems."

The possibility of coating pipes already in use and the chemicals to be used have been known for years, but, as Dr. McCauley noted, the applications to date have been on a "by guess and by golly" basis. By treating the problem scientifically, he found the precise portions of chemicals needed to do the most effective job.

Moreover, a new factor which he found important is that the rate of flow of the water carrying the chemicals must be very fast. The results of tests have been very promising: "The coating is hard, even and fine. We feel sure it will work even in systems in which the pipes are now coated with rust."

The method calls for the addition of metaphosphate and one or more of the following chemicals to the water: lime, soda ash, caustic soda and calcium chloride. Since these chemicals are often normally present in the water, the amounts and types depend on what is already there.

The treated water flows through the pipes at six feet per second. After two hours, the pipes are coated with a hard, thin layer of limestone (calcium carbonate), and normal water may be returned to the pipes.

Dr. McCauley pointed out that although the chemicals are harmless in the amounts used, the treated water is slightly distasteful. Thus, it would be best to treat "only one section of a city at a time, and then during the early hours of the morning when few people are using water. A few hydrants could be opened to make the water flow rapidly."

Water Softening and Stability Conference

The Missouri Section of the American Water Works Association and the University of Missouri are sponsoring jointly a one-day conference on the subject of water softening and the stability of softened water. The conference will be held at the University, at Columbia, Missouri, April 6, and about half of the program will be devoted to papers and discussion of the stabilization of the lime softened water.

Other subjects to be discussed will include new experiments in low temperature lime slaking, and the disposal of softening wastes.

Consoer, Townsend Expand

Consoer, Townsend and Associates have opened a branch office in Silver Spring, Maryland. Fred N. Van Kirk has been named as branch manager of the Silver Spring office.

No brain is stronger than its weakest think.

Self-Liquidating Plant Eliminates Sludge Disposal Sites as . . .

Dayton, Ohio Recalcines Water Softening Sludge

A STAFF REPORT

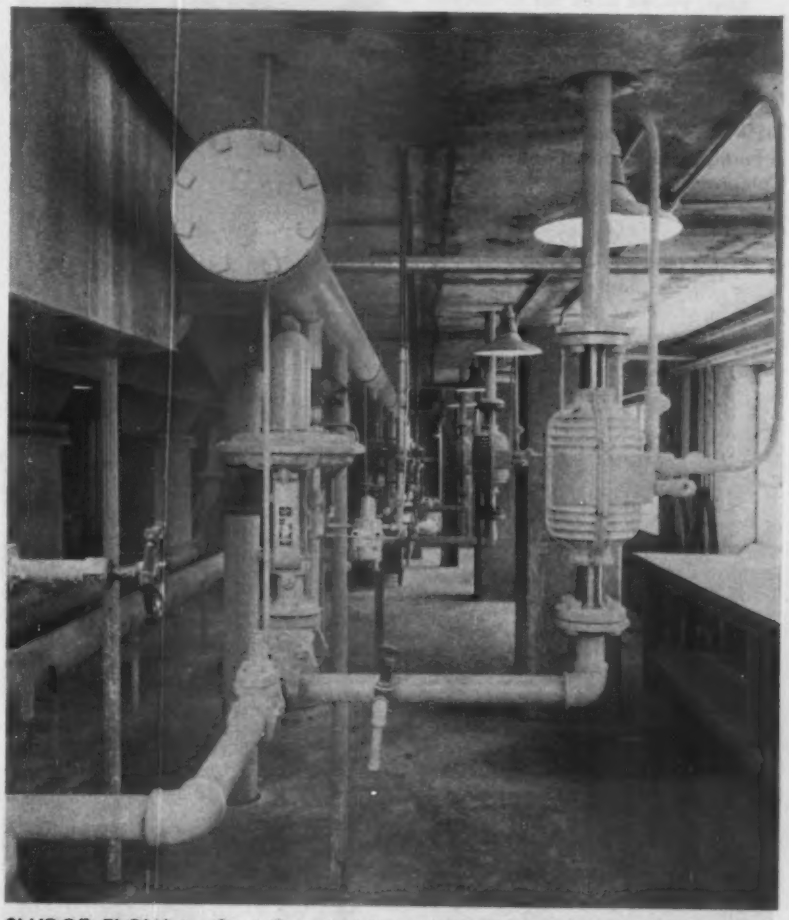
ED. NOTE: One drawback to construction of lime-soda water softening plants is availability of sludge disposal sites. Recalcination solves this problem and provides lime for sale to other communities at Dayton.

■ MOST OF US, when faced with a problem, would prefer to eliminate the cause than to correct a troublesome effect. Often, restrictions on available sites for sludge disposal have outlawed construction of lime-soda softening plants. Take the case of Dayton, Ohio where lagoon sites became filled. After study, officials decided to remove the cause of the problem. Instead of disposing of sludge to lagoons, they decided to dewater the sludge and return it to useable quicklime.

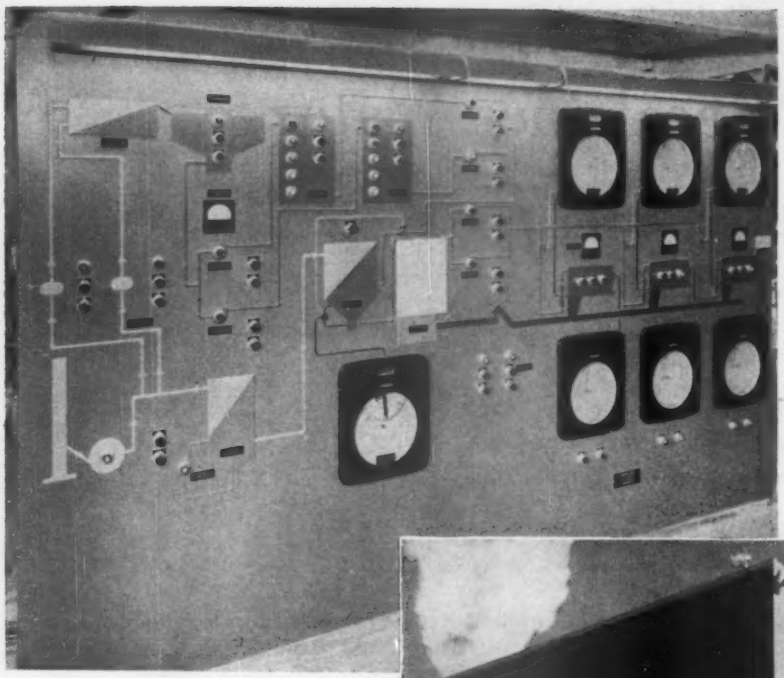
The accompanying photographs show the results of their study and planning. Built at a cost of $1.5 million Dayton's recalcination plant can produce 150 tons/day of pebble quicklime. At present, sludge is hauled in water, recarbonated, clarified, from an abandoned pit, resuspended thickened and burned at 2000° F. Calcination occurs in an inclined kiln as illustrated.

Fortunately, not only is the product of high quality (91-92% available CaO), but production rates permit sale of lime to nearby communities. This provides income which, combined with a savings on Dayton's lime bill is contributing to a 20-year amortization of the plant cost. Also involved is CO_2 conservation from the recalcinator stack gas for use in recarbonation.

Engineered by Black and Associates, Gainesville, Florida, the Dayton Recalcination Plant incorporates the latest in systems design and control equipment. W. T. Eiffert is Director of Dayton's Water Department, R. C. Stout is Superintendent of Water Supply and Treatment and Ralph Taylor is in charge of the recalcinator. Photographs courtesy of Foxboro and Allis-Chalmers.

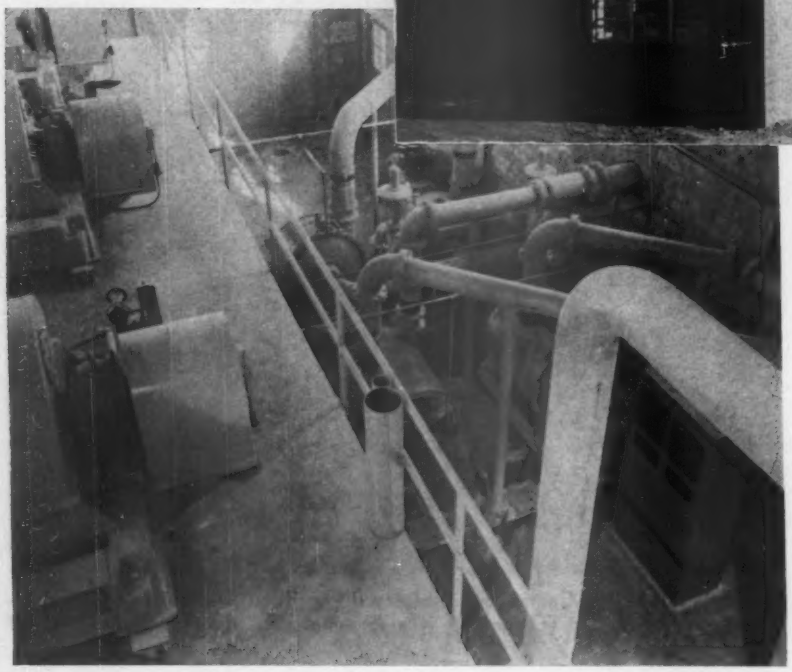


SLUDGE FLOW to Centrifuge is Metered by Three Magnetic Flow Meters Shown at Right. Left Foreground is a Pneumatically Actuated Flow Control Valve.

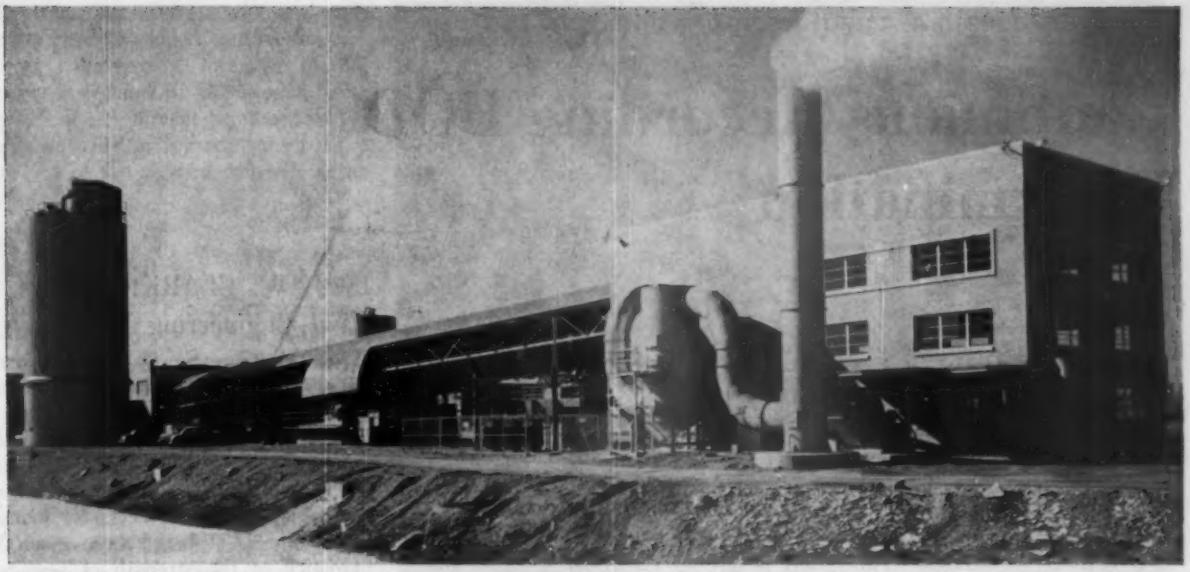


GRAPHIC CONTROL Panel Contains at Top, Flow Recorder-Controllers; Bottom Left, Liquid Level Indicating-Recording-Controller and Bottom Right Recorders for Centrifuge Torque with High Point Cut-Outs.

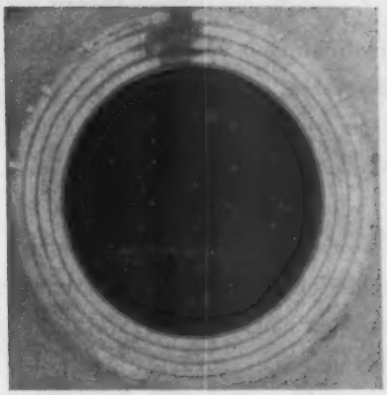
VIEW OF Recalcination Plant. Building in Foreground Houses Centrifuges and Compressors.



VIEW OF Compressors Which Reclaim Stack Gas CO_2 For Recarbonation.

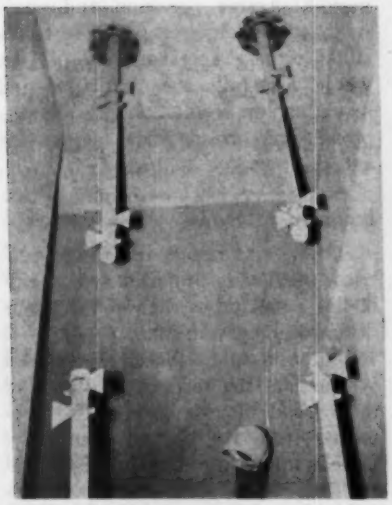


EXTERIOR VIEW of Dayton, Ohio Recalcination Plant.

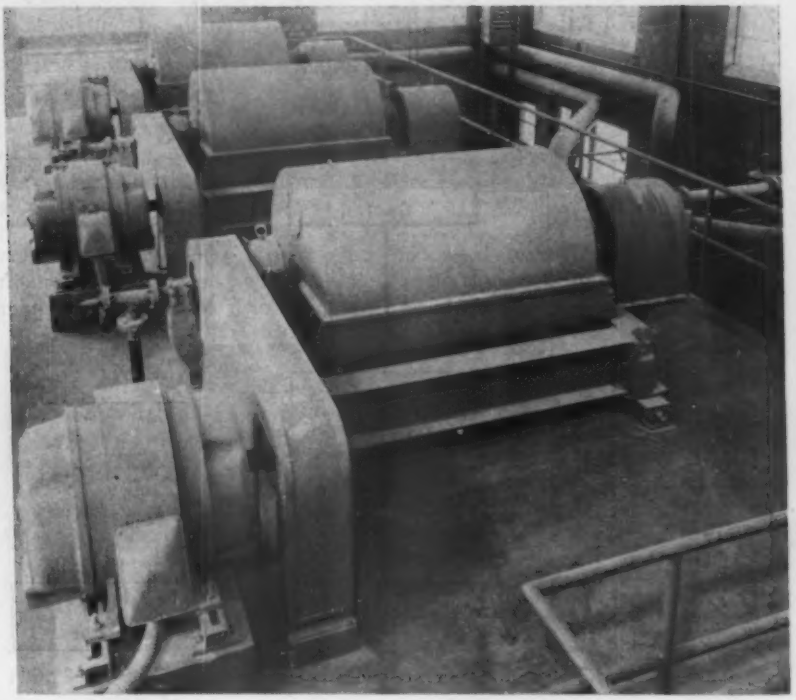


INSIDE the rotary kiln, the firing hood and nozzle form an interesting contrast to the refractory walls. Jointless lining was installed in the hood before initial firing.

CENTRIFUGES CONCENTRATE Sludge to 65% by Weight.



EXPANSION CHAMBER at feed end of the 9½ x 265 ft rotary kiln incorporates spray bars allowing the calcium carbonate slurry to be preheated.



A potential for much fruitful research is opened by . . .

Continuous Recording BOD Determination

by J. W. CLARK, Prof.
Civil Engineering Dept.
New Mexico State University
University Park, N. M.

EDITOR'S NOTE: Few arguments will be raised to the contention that the BOD determination is one of the most useful tools of the sanitary engineer. Even fewer arguments would follow the comment that it is a determination about which there is still a lot to be learned which could improve even its usefulness. In particular our knowledge of the true shape of the curve of BOD vs time is somewhat limited. Many methods are available, although usually quite laborious, by which a large number of points of the curve can be obtained. Also manometric techniques which are somewhat less work have been used to obtain even larger numbers of points. For what appears to be a much smaller investment of time and manpower the methods developed by Mr. Clark produces a continuous plot of the oxygen demand against time. The application of the method would seem to have the potential of establishing as fact many of the contentions regarding the BOD curve.

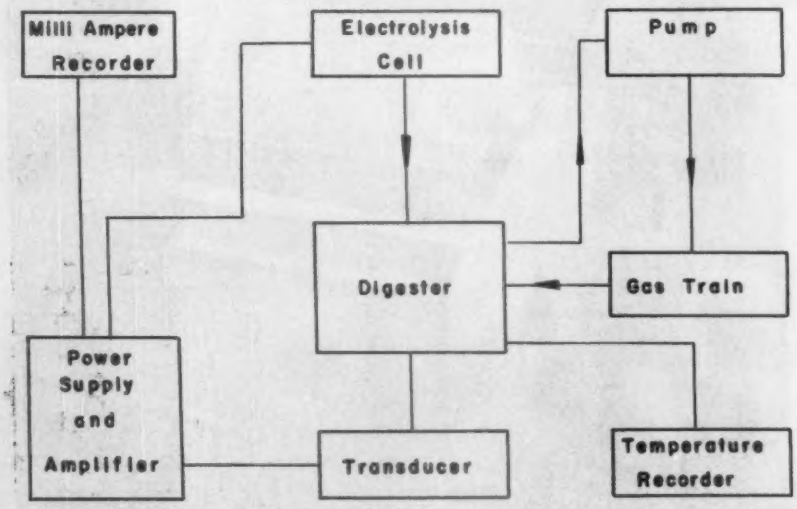


FIG. 1 SCHEMATIC DIAGRAM of the system

■ THE BOD TEST has attracted the interest of sanitary engineers for many years and is still the best general yardstick of the strength of sewage and industrial waste. The efficiencies of individual plant components and the plant as a whole is largely determined by BOD reductions. The ability of the receiving stream to assimilate BOD loads determines the degree of treatment. Most industries and a great number of small municipalities pay for sewage treatment according to a scale of charges based on flow and BOD. The principle of BOD is used in research in tissue metabolism and in other aerobic digestion studies.

Some changes which would improve the standard five day bottle dilution test are: a shorter test period, greater precision and accuracy, continuous record of test, results more representative of the whole, less influence of method and procedure on results, and results expressed as an electrical signal for automation.

Proposed Method

A new continuous recording electrical method is proposed which embodies a portion of each of the above desirable improvements.

Digestion takes place in a closed system. As the oxygen is used and the carbon dioxide given off is removed from the system chemically, there is a pressure drop in the digester. This rate of pressure drop is converted to an electrical current by means of a transducer and power supply. An electrolysis cell is connected to the pressure controlled power supply. In this cell oxygen is given off at the anode and made available to replace that used in the

digester. Measurement of the electrical energy developed by the pressure drop will give a measure of the oxygen demand of the system. The graph of the current produced which is recorded on a strip chart is a picture of the oxygen demand of the system.

Equipment

The oxygen recorder is a strip chart recorder. The range used was 0-500 millamperes with a calibrated accuracy of 0.2 percent with automatic standardization. A chart speed of two inches per hour was normally used for 5 day BOD's, but a speed of 10 inches per hour was used for short time critical studies. The chart is 11 inches wide and requires 24 seconds for full scale pen travel.

The pressure servo and power supply is the result of a cooperative effort on the part of Robert Stark, and the Sanitary Engineering Laboratory Staff. The equipment in use was designed and built by Mr. Stark, who is a part time student at New Mexico State University.

The pressure servo which is in two parts, the transducer and the amplifier, Figs 3 and 4, is a device for detecting a minute change in pressure and converting this change into an electrical current.

The transducer converts a change in pressure into an electrical potential by means of a pressure diaphram in the unit which actuates a variable condenser connected into two legs of a capacitive bridge. This bridge circuit was excited by a radio frequency signal from the amplifier. The two outputs of the bridge were rectified oppositely and these two DC voltages were summed to provide the output signal. When the bridge is in balance, their resultant voltage will be zero, when the bridge is unbalanced by movement of the diaphram, the output signal will turn to a voltage similar to the larger, Fig. 4. The amplifier unit of the pressure servo amplifies the resultant voltage from the transducer through the use of standard half-wave rectifiers Fig. 5. The current from the amplifier was connected in series with the recorder and electrolysis cell. The electrolysis cell was made of two 250 ml Erlenmyer flasks containing the electrodes and connected by a short piece of glass tubing at their base, Fig. 6.

The flask containing the anode was sealed into a piece of 8 mm glass tubing and connected with plastic tubing to the digester. The flask containing the cathode was connected by a short piece of tubing to the outside air so the hydrogen liberated could

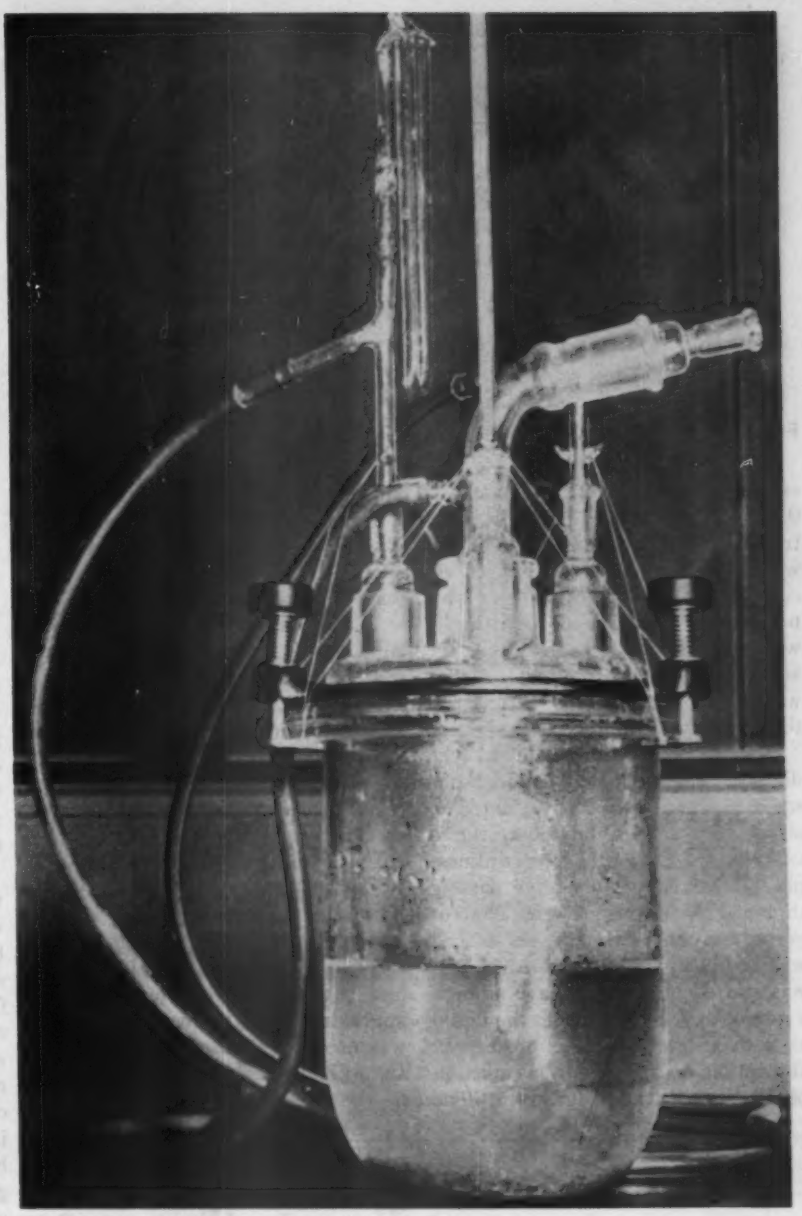


FIG. 2 THE DIGESTER assembled for use

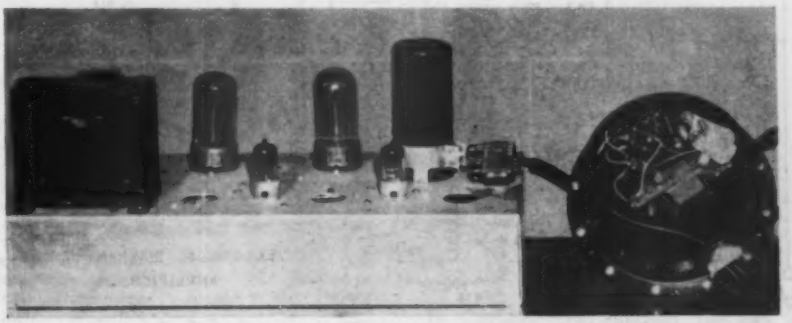


FIG. 3 TRANSDUCER AND AMPLIFIER

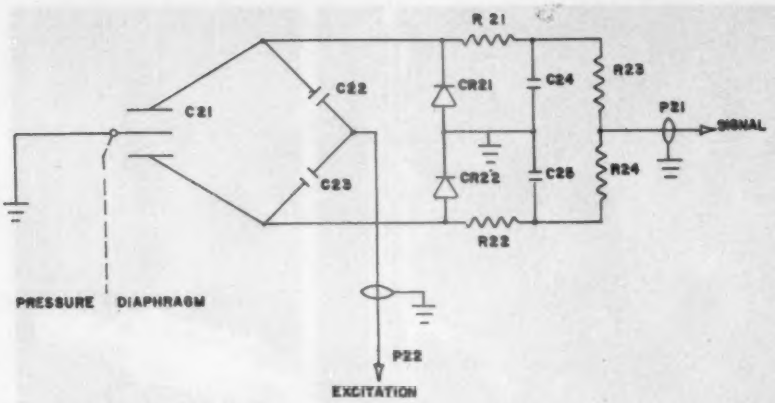


FIG. 4 CIRCUIT DIAGRAM of pressure servo

escape. The electrolytic solution was 0.05 N sulfuric acid and the electrodes were platinum. Originally it was planned to check the oxygen recorder with a silver coulometer connected in series, and periodically weigh the electrodes to determine the amount of silver deposited, but this was found unnecessary because of the accuracy of the recorder.

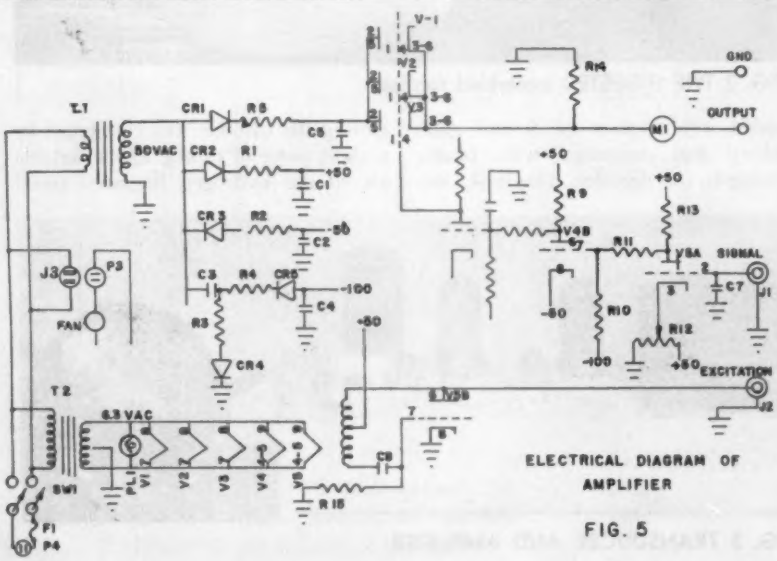
The oxygen atmosphere in the digester was circulated in much the same way as described by Porges, et al.[3] in their carbon dioxide evolution experiments, except the oxygen atmosphere was recirculated after passing through the drying tower. The digester and tubing system was flushed with cylinder oxygen before the run was started in order to have as high a rate of oxygen transfer to the liquid as convenient. The rate of oxygen absorption by a liquid is a function of the concentration gradient. The distilled water was saturated with oxygen prior to being placed in the digester and the system was reflushed after the water was added. The oxygen atmosphere in the digester contained approximately the same amount of oxygen at the start of a BOD run as it did 5 days later. A typical analysis showed 80 percent oxygen before and after the run, zero carbon dioxide, and the remaining 20 percent was assumed to be nitrogen. The absence of carbon dioxide before the run was due to the passing of all flushing gases through a scrubbing tower containing a 1 N potassium hydroxide solution.

The digester was a 2 liter resin reaction vessel with standard cover and clamp. A liter of waste of approximately 4,000 mg/l 5 day BOD was used for most runs. The oxygen atmosphere was drawn from the top of the digester through the pump, potassium hydroxide and barium hydroxide scrubbing towers, calcium chloride drying tower and into the liquid through a small rose bud, approximately 2.5 cm. off the bottom center of the digester. Circulation in the digester was provided by a magnetic stirrer operating a ¾-in. by 1 ⅜-in. magnet with plastic cover. The stirring speed was adjusted until a slight vortex was just visible at the surface of the liquid and then slowed until the vortex just disappeared. This was assumed to give approximately the same degree of agitation for all runs. Connected to the cover by ground glass joints was a thermometer, water manometer, pressure diaphram, pump suction, and air inlet tube.

The water manometer served a dual purpose in that it gave direct indication of the pressure difference inside the digester as compared to the atmospheric pressure and that it served as a compensator for changes in outside air pressure. If the manometer opening were plugged, the changes in atmospheric pressure would be superimposed on the current curve and it would be necessary to make a correction for this value.

All of the equipment except the recorders, power supply, and pump was contained in a modified BOD box. A standard dry BOD box that maintained the temperature within 0.5° C caused too much variation in circulated air temperature for best operation. The cycle of the heating element was superimposed on the recorder chart. No serious error was introduced, as it was averaged out, but considerable smoothing of the graph resulted from the box modification.

The modification consisted in building an aluminum container to fit inside the BOD box while still allowing free circulation around it. The experiment was carried out inside the aluminum container. A plastic door was placed on the aluminum container so that the BOD box door could be opened for observation without upsetting the temperature balance. Most of the extreme temperature sensitivity could have been corrected in the electrical and hydraulic system, but it was decided to continue without dampening. Temperatures were recorded in the laboratory, in the BOD box, inside the aluminum box, and inside the digester. These temperatures were



ELECTRICAL DIAGRAM OF AMPLIFIER

FIG. 5

recorded on a strip chart printing recorder similar to the oxygen recorder.

The pump used for circulation of the oxygen atmosphere was a Sigmamotor model T6-S with variable speed drive. The rate of circulation of oxygen was constant for all experiments, 150 ml per minute. This value was periodically checked and found to remain constant over the 5 day BOD period. Plastic tubing ¼ in. ID was used throughout the experiment for pump hose.

On runs where it was necessary to enter the digester for sampling, or in any way interrupting the process, two identical runs were used and one digester was always untouched and used as a control.

Method

For each test, the digester and all of its appurtenances were assembled in the incubator and connected. All pieces of equipment that came in contact with the synthetic sewage had been washed and sterilized so that the run would not be affected biologically by the previous run. The system was flushed with cylinder oxygen in order to have a high oxygen atmosphere in the digester and to saturate the solutions in the gas train with oxygen. A slight vacuum (0.1 inch of water) was produced inside the digester by exhausting some of the atmosphere through a valve on the pressure side of the pump. The lowering of pressure called for oxygen from the electrolysis cell and this was allowed to reach equilibrium. This developed an oxygen saturated condition in the liquid of the cell.

The dry ingredients for the synthetic sewage were transferred to the digester through an opening in the top. One liter of distilled water at 20° C was added and the magnetic stirrer was adjusted until the vortex produced at the center of the container disappeared. Seed was added in various quantities dependent upon the source of the seed for the particular test. For raw sewage and activated sludge as seed, 10 ml of supernatant from a sample which had been standing for one hour was used.

The digester was again flushed with cylinder oxygen through the diffusor tube at the center in order to saturate the substrate with oxygen. A slight pressure, about two inches of water, was left in the digester. 150 ml. of the atmosphere was taken from the digester for gas analysis to determine the percentage of oxygen. The circulating pump was started and the system was adjusted to atmospheric pressure by bleeding of gas from the pressure side of the pump. The barometric pressure was recorded at this time in order to correct for the volume of gas remaining at the end of the run. The pressure servo was adjusted to zero and the temperature and current recorder chart drives turned on. The plastic door of the aluminum box was closed and sealed with masking tape.

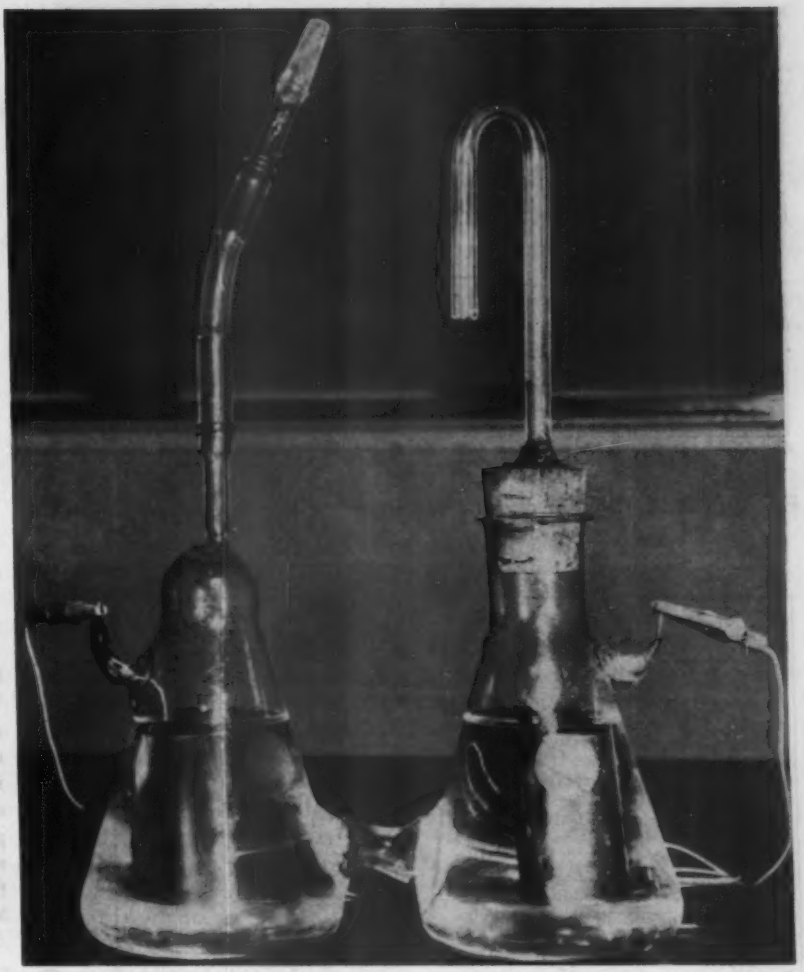


FIG. 6 ELECTROLYSIS CELL

At the end of the run a sample of the atmosphere in the digester was withdrawn for gas analysis in order to determine any change in the oxygen content. The pH was taken and the barometric reading noted. The chart was removed from the current recorder and the BOD calculated. For the purpose of calculation and plotting, a six hour running average was used.

The composition of the synthetic sewage used in most of these studies is shown in Table 1. This medium produces a 5 day BOD of 4,000 mg/1.

Table 1
Composition of Synthetic Sewage

	Concentration (g/l)
urea	0.30
starch	1.20
peptone	1.80
gelatin	0.60
skim milk	1.80
di-sodium hydrogen phosphate	0.30
potassium chloride	0.04
calcium chloride	0.04
magnesium sulfate	0.03
ferric sulfate	0.03

Results

In this electrical method, the biochemical oxygen demand curve is the

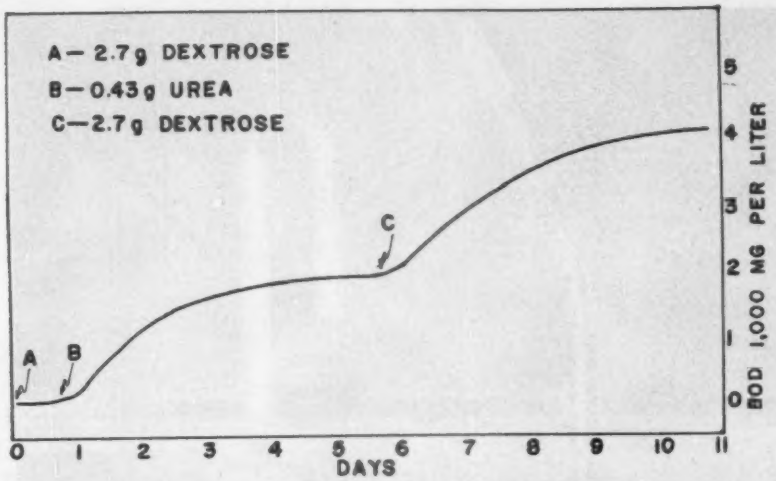


FIG. 7 BOD VS TIME for dextrose as determined by the electrical method

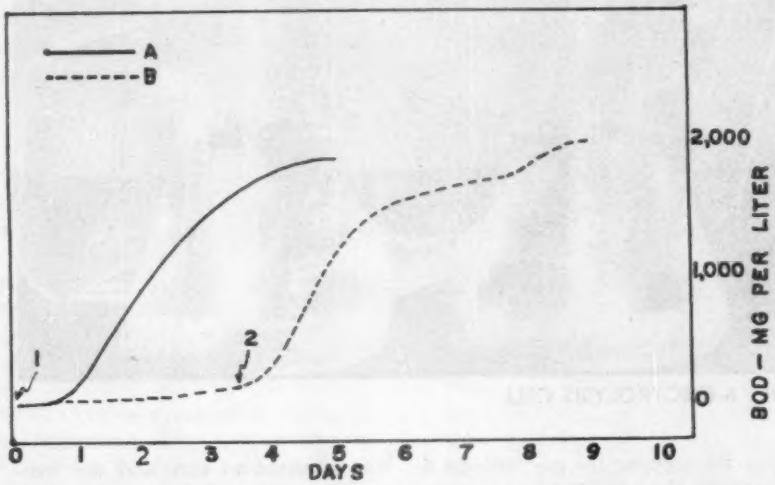


FIG. 8 BOD VS TIME for dextrose with and without sufficient nitrogen for metabolism

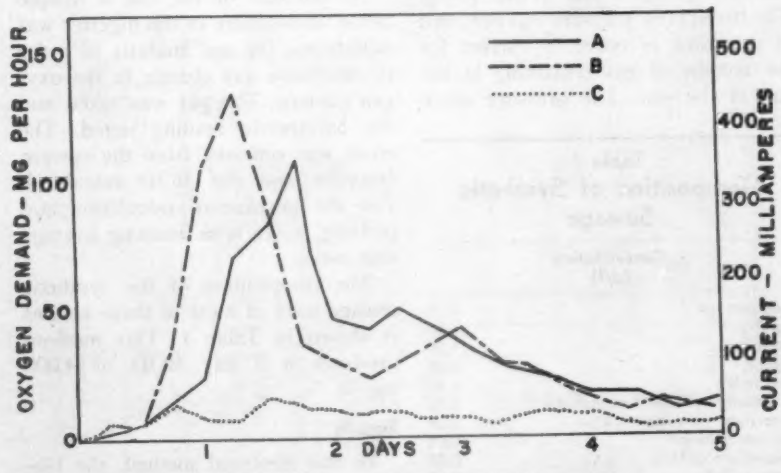


FIG. 9 EFFECT OF VARIOUS types of seed on BOD results

current curve with the units changed. Amperes is a measure of the rate at which electrons are flowing and, therefore, the rate at which electrolysis is taking place. The coulomb is the unit of quantity of electricity. A current of one ampere flowing for one second carries one coulomb of electricity past a point in the system. A coulomb measures a definite number of electrons. A faraday is 96,500 coulombs. The faraday is the charge on 6.023 x 10^{23} electrons, (Avogadro's number). One faraday will deposit one gram-equivalent weight of an element —107.88 grams of silver, 8.00 grams of oxygen, etc. The upper limit of the power supply used in most of these experiments as connected was 460 miliamperes. This is equivalent to 0.0022 grams of oxygen per minute, 0.133 grams per hour or 16 grams in 5 days. This would supply a theoretical biochemical oxygen demand of 16,000 mg/l on a one liter sample but, this is not possible practically. Within the limits of this equipment, a biochemical oxygen demand of 5,000 mg/l is the upper limit without modification. The modification would be easy and only necessitate a larger power supply. This would be necessary for only the strongest of industrial wastes or specific research problems.

BOD's have been run using the electrical method on synthetic sewage and pure substances from 1000 to 5000 mg/l of oxygen demand in 5 days. Results can consistently be duplicated within 5 percent of the calculated carbonacous BOD. The present electrical equipment is calibrated to be used on strong wastes but modification is under way to run tests within the range of 0 to 1000 mg/l of 5 day oxygen demand.

The tests have been run primarily to test the equipment under various conditions and prove its worth as a research tool. Fig 7 represents the graph from the recorder chart during the reduction of dextrose. At time zero (point A) 2.7 grams of dextrose were added to the digester with one liter of standard dilution water[1]. Five milliliters of supernatant from fresh activated sludge was used as seed. The slope of the BOD curve for the first 18 hours (point B) was similar to the oxygen demand of 5 ml of this type seed Fig 8. This is as would be expected in a nitrogen poor environment (BOD/N = ±1000/1).

Because standard dilution water contains only enough nitrogen for the 6 to 8 mg/l of BOD actually exerted in a bottle while the full BOD was exerted in the equipment, it was necessary to supplement the nitrogen in standard dilution water with urea.

Three hours after the urea was added, a normal BOD curve developed which resulted in a 5 day BOD of 2000 mg/l. At this point (point C) an additional 2.7 g of dextrose was added which resulted in another 2000 mg/l of oxygen demand in 5 days. The total oxygen demand for the 10 day period was slightly over 4000 mg/l because the first dextrose added exerted a BOD over a 10 day period.

In Fig 8, two simultaneous runs were made on dextrose. For curve A, 2.7 g of dextrose and 0.43 g of urea were added at point 1. For curve B, 2.7 g of dextrose but no urea was added at point 1. One liter of standard dilution water was added to each digester with 5 ml of supernatant from fresh activated sludge as seed. Curve A developed a normal oxygen demand of 2000 mg/l in 5 days. Curve B had an oxygen demand of 149 mg/l in 3.5 days (point 2). At this time 0.43 g of urea was added to the digester and in about 3 hours, a normal BOD curve started. This second curve was not smooth for the last day and one half and indicated that nitrification was taking place.

Fig 9, curve A represents the normal BOD curve by the electrical method of the synthetic sewage listed, using the supernatant from settled fresh raw sewage as seed. This curve with its shape characteristics has been reproduced over a two year period with a maximum deviation of 5 percent of the calculated 4000 mg/l of 5 day oxygen demand. Considerable variation in the shape of the curve has resulted from the use of various seed. Using activated sludge from a previous run results in a shorter lag period, higher peak demand and a 5 day BOD in excess of the calculated carbonacous demand, Fig 9 curve B. Similar shaped curves were produced with this synthetic sewage when trickling filter effluent and activated sludge over three days old was used as seed. Curve C was produced when a lyophilized seed was used where a major portion of the population was destroyed.

Conclusions

The electrical method for BOD determination should find wide application in biological research and sewage plant operation.

Some of the advantages over present methods are:

1. A shorter test period is required because the shape of the initial curve can be correlated to previous runs for extended results.
2. BOD's can be produced with better precision and accuracy than with conventional methods.
3. A continuous record of the test gives considerably more information than a total end result.
4. The results are more representative of the whole because it is easier to obtain a representative sample with a larger volume.
5. There is less influence of method and procedure on results as compared to conventional methods.
6. The results are expressed as an electrical signal which makes it easier to automatically control a process.
7. A minimum of laboratory skill is required for routine plant operations. The electrical method could be adapted to produce a BOD on a meter face by the routine turning of a switch.

Acknowledgements

This study was supported by a research grant from the National Institutes of Health, U S. Public Health Service.

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Act to Prohibit Ships from Polluting Great Lakes

Ships on the Great Lakes and St. Lawrence Seaway will be prohibited from polluting the water supplies of port communities by a new ruling issued today by Dr. Leroy E. Burney, Surgeon General of the Public Health Service.

Effective when the Seaway opens this spring, the new ruling requires ships either to avoid the areas from which communities draw their water supplies or to adopt specific safeguards against pollution.

The Public Health Service is obtaining data on currents and other conditions of water intake areas from State and local health authorities which it will use to chart the areas where dumping of untreated waste will be prohibited.

Each ship captain, upon entering the Seaway at Montreal, will be given charts of the delimited areas of all the ports on his route. Ships entering these delimited areas must follow one of several methods of controlling pollution while there: they can treat their waste material by an approved sewage treatment device; store it in suitable retention tanks until they leave the area; empty it into the port's sanitary sewer system; adopt any other method of handling their waste which meets the approval of both the local authorities and the Public Health Service; or unload garbage on the dock only if there are adequate facilities for handling it.

About 100 areas will be designated. Local authorities will be responsible for surveillance and will report violations to the Public Health Service. Penalty for violation can be either fine or imprisonment.

Collins Receives Birmingham Appointment

The appointment of Thomas H. Collins as General Manager of the Water Works Board of Birmingham was announced today by A. C. Montgomery, board chairman.

He succeeds E. Clinton Smith who is resigning as General Manager in order to take over the management of the East St. Louis and Interurban Water Company in East St. Louis, Ill.

Collins is past president of the Alabama Water and Sewerage Association, and also a member of the American Water Works Association.

Mr. Smith served as Assistant General Manager of the Birmingham Water Works from 1949 to Feb. 1, 1957.

He returned to Birmingham as Manager after the death of Mr. H. L. Shiflett and has served in that capacity since June, 1957.

Oceanic wastewater disposal requires study of many factors including . . . . .

Wind Drift in the Waters of the Southern California Shelf

by ROBERT E. STEVENSON,
Director of Inshore Research
Allan Hancock Foundation
University of Southern California.

ED. NOTE: Increased use of the ocean for wastewater disposal makes mandatory the study of major ocean currents, tides, density variations, earth rotation and winds. This report summarizes the role of wind in moving water over southern California's mainland shelf.

■ THE SUCCESS of any ocean effluent outfall depends primarily upon the movements of the receiving water. Proper engineering design can aid by increasing the initial dilution which is important in reducing bacteria numbers. Even so, if the ocean receiving the effluent has characteristics which result in little dispersion of the sewage field, or currents that carry the discharged material rapidly to shore; then no amount of engineering short of complete treating facilities can assure proper disposal.

In California, only the new five-mile outfall of the City of Los Angeles and the proposed outfall of the City of San Diego have been designed following adequate oceanographic surveys. All other outfalls that are functioning within the standards established by regional Water Pollution Control Boards, are doing so by fortuitous placement. There are several that are not operating with efficiency and have, or will, require expensive modification. It is obvious, thus, that any discharging agency should know as much about the receiving waters as is possible within the bounds of their prevailing economic situation.

The most practical information from the standpoint of the discharging agency is the structure and patterns of the local ocean currents. A general knowledge of the grand current systems in the vicinity is of little value because (1) the major currents rarely carry water over the shelf, (2) the water over the shelf differs by varying degrees from oceanic water, and (3) the shelf area, when compared with the magnitude of the ocean, is minute. Therefore, we find that winds, tides, and minor density variations are the important forces in generating lateral water motion. Friction from the sea floor and barrier effects from the coast become significant to the extent that the complexity of water movements can only be detailed by the acquisition of empirical data.

It is recognized that often, perhaps usually, a discharge agency may find it disadvantageous, for one reason or another, to initiate an oceanographic investigation of any sort. But because of the necessity of knowing at least the elements of the current system in the receiving waters, some method need be known to obtain information quickly and easily.

Studies by two organizations and a few individuals of the nearshore currents in southern California have resulted in data that show a definite relationship between the wind and local surface currents. It is rare that information of the local winds is not available. Thus, by applying wind data, some understanding of the local current patterns may be learned. This, then, will determine the magnitude of the further work that will, of course, be necessary prior to final location and design of the outfall.

With these various considerations in mind, I have collected data into this report which I feel will be useful to those involved in ocean disposal. I must add this caution, however, that forces other than the wind are important in controlling current systems and that from the local winds one can gain only part of the total current pattern.

General Statement

Ocean currents are conveniently divided into three groups: (1) currents which are related to the distribution of density, (2) currents which are the direct result of wind stress on the sea surface, and (3) currents associated with tides and internal waves (Sverdrup, Johnson & Fleming, 1946).

The large scale currents of the oceans belong to the first class, such as the Gulf Stream, Kuroshio, California Current, and others equally as well known. All of these transport great volumes of water, and their courses remain seaward of the mainland shelves. Off southern California eddies or gyrols from the California current approach the coast but lose their identity over the shelf.

Effective water motion over the shelf is developed primarily by wind stress on the sea surface, and in some areas by the tide wave. Where the wind prevails in one direction over large areas, the resulting wind drift of surface waters will be uni-directional. Tide currents, on the other hand, run alternatingly in opposite

directions, and thus are of no direct importance to the circulation of ocean waters. Over the shelf, and especially near shore, winds are more often than not controlled by local heating and cooling, so that the surface drift due to wind stress is neither constant nor in the same direction. In such areas alternating tide currents could be of greater significance than wind-driven currents.

Any motion in the atmosphere or ocean must take into account the effect of the earth's rotation (Coriolis force). In nearly all other problems of mechanics, Coriolis force can be neglected because other forces acting are much greater, but in the ocean it becomes significant. The deflection due to Coriolis effect is proportional to the speed at which the mass travels, is directed at right angles to the velocity, and to the right looking down current in the northern hemisphere.

Wind Currents

The stress that the wind exerts on the sea surface leads directly to the development of a shallow wind drift.

Subsequently, the water transported by the wind drift alters the distribution of density which develops corresponding currents. The latter process is most significant in oceanic areas where prevailing winds dominate for sufficient time for currents to develop. Near coasts, where the winds are variable and often diurnal in nature, density distribution changes so rapidly that permanent current patterns are never established, although one system may dominate all others. In the near shore area, the density distribution rarely dominates the water structure to the extent that currents result. There are instances where density currents are present, but mostly the wind drift is the outstanding feature of water motion.

When the wind exerts a stress on the sea surface, which sets the surface layer in motion, this moving layer of water exerts a stress on the next underlaying layer, and so on. These latter stresses are appreciable even when the velocity difference between adjacent layers is small, because of the high value of eddy viscosity. Ekman (1902) examined theoretically the wind drift, assuming eddy viscosity to be constant, and noted that in the northern hemisphere the wind drift at the surface is directed 45° to the right of the wind. With the increasing depth of water, the angle between the current and the wind increases, and the velocity of the current decreases. If the velocity at equal intervals of depth is represented by an arrow of the correct direction and appropriate length corresponding to the speed, the arrows will form a spiral staircase, the steps of which become narrower as the depth increases.

Obviously a depth always exists at which the current flows in a direction opposite that of the surface current. At this depth the velocity has decreased to a small fraction of its value at the surface, and below this depth, the currents are negligible. Ekman called this depth the *depth of frictional resistance*. The depth of frictional resistance increases with the increasing wind velocity and with decreasing latitude. The relations between depth of frictional resistance, D, wind velocity, W, and latitude, a, are expressed approximately by $D = 7.6W \sqrt{\sin a}$. The depth is obtained in meters when the wind velocity is given in meters per second. From Ekman's calculations the velocity of wind drift at the sea surface is $V = 0.013\ W \sqrt{\sin a}$. Such theoretical wind drift can develop only in the open ocean in regions where the wind blows in the same direction and with a constant velocity over wide areas. Near coasts where neither directions nor velocities prevail for more than a few hours and where the barrier effect of the coast becomes significant, marked deviations occur in wind drift patterns.

Secondary effects of the wind may, on occasion, be important in shelf waters. Consider a wind in the northern hemisphere blowing parallel to a coast which is on the right hand of an observer with his back to the wind, and assume that the density of the water increases with depth, primarily because the temperature decreases. The direct effect of the wind leads to the transport of light and warm surface water shoreward. But because the coast represents an obstruction to the flow, the light and warm water "piles up" against the coast. At some distance offshore denser and colder subsurface water must rise to replace that which has been carried toward the coast. The distribution of density is thus altered, and, as a secondary effect, a current develops which flows in the direction of the wind according to the rule that the lighter water shall be on the right hand side of the current. Such a distribution of density and subsequent current develops along parts of the southern California coast, when southeast winds preceding frontal storms blow for 24 hours or more (Stevenson and Gorsline, 1955). Once the system is formed or a steady state is reached, the density pattern and currents may persist for 24 to 72 hours following the storm.

If the coast lies to the left of the wind direction the light and warm surface water is transported seaward, and is replaced by denser and colder subsurface water next to the shore. This process, known as upwelling, again leads to an altered distribution of density to which a current flowing in the direction of the wind corresponds. Experience has shown that such upwelling is restricted to shallow depths, and over the Los Angeles and Orange County shelf its effect can be traced to about 200 feet (Stevenson and Gorsline, 1955). The intensity and gradient followed by upwelling water varies with the strength of the winds and the width of the shelf. Along the Newport-Huntington Beach coast in Orange County, California, it is a minor feature due to the wide shelf, but it exists more often than not, varying in intensity and extent as the dominant westerly winds vary. When rhythmic land and sea breezes occur, upwelling patterns and subsequent currents often "pulsate"; the lower pulse being during the land breeze hours.

Current Viscosity

In dealing with the movements of effluent discharged from ocean outfalls we are primarily concerned with the movement of the upper two to four feet of the ocean surface. This is where the low density effluent is concentrated and where the high bacteria numbers occur. In addition, because of the density difference, the effluent is more readily affected by wind drift. We must not, nevertheless, restrict our study to this thin layer, for the motion of the underlying water also has varying effects on the surface drift.

Theoretical analyses of water motion over continental shelves have been few in number. Various phases

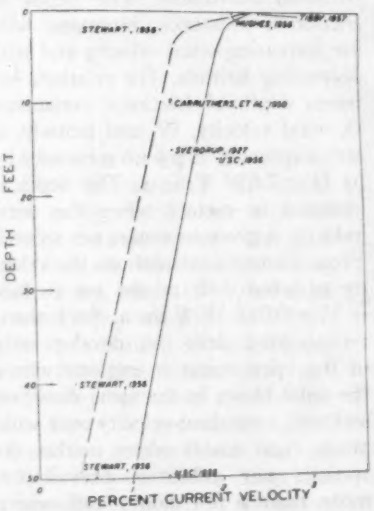
of the problem have been reported on by Hidaka (1954), Arthur (1954), and Leipper (1957). None of these aid in determining the velocity of water movement. One paper applicable in this respect is by Fleming (1938); in which current velocities developed by tidal action are discussed, Since less than 20 per cent of lateral motion over the southern California shelf is due to tidal conditions, even that report, though of considerable interest, does not allow determination of current velocities.

We must, therefore, turn to empirical studies of water movement in nearshore waters. In each the drift of various objects has been noted and the relationship to the wind calculated. Most of the objects have been artificial, and placed by the observers into the water at specific times and places. Sverdrup (1927), however, made his evaluations by studying the drift of pack ice during the "Maud" expedition in the Arctic Ocean. Over a period of many months he concluded that the pack drifted at a velocity of 1.5 per cent that of the wind. This figure has been used since that time by casual observers to denote the expected velocity of surface currents and/or objects other than ice in other areas. Such a use and an assumption must be viewed with suspicion, because, as Sverdrup noted, many factors effected the flow of ice; i.e., pressure by adjacent ice packs, grounding of the ice, and the convergence of ice packs. He did establish, though, a definite relationship between the wind and the surface drift of the ocean.

In the Dover Straits, Carruthers, Lawford, and Veley (1950) found that the water movement was 1.5 per cent of the wind travel at a depth near ten feet. This figure is backed by about three years of continuous current and wind measurements taken from a lightship; so the accuracy of the conclusions is considered good. Although this information is certainly more applicable than that of Sverdrup's because the area is a strait, it cannot be considered as truly representative of an open shelf.

A complete discussion of the literature is not made here in regards to the problem of wind drift versus wind velocity, for much is not applicable. But, from the following work we note there to be a considerable conformity. This is particularly true in studies carried out by Stewart (1956) Tibby (1957), and by the Staff at the Hancock Foundation, University of Southern California, in 1956, for their areas of investigation were over the southern California shelf. The work by Bowden (1953) and Hughes (1956) shows differences mainly because the regions studied were in the open sea where the water motion is unrestricted.

Surface Motion:—Hughes conducted his field study in the Atlantic west of the British Isles. Unweighted plastic cards were dropped from aircraft about 140 miles at sea. During the period of drift, analyses were made of the wind system to determine the direction and velocity of the surface air flow. The results showed that cards travelled at 2.2 per cent the velocity of the wind, and there was no deflection of their course from the wind direction. Although this was a noteworthy study, the results must be weighed against the method employed. First, there were no wind observations; the direction and velocities were computed from daily weather charts as gradient winds. These must certainly differ to some extent from the actual winds at the sea surface. Secondly, because unweighted cards were used, it is likely that at higher wind velocities (greater than Beaufort Force 4) the cards were blown from one wave crest to another. Thus, rather than representing the water movement of the upper two or three feet of the ocean, the directions and velocities of the cards were more representative of a thin surface film (say, one or two centimeters). Hughes, therefore, considered that the wind factor was probably too high, and the drift angle closer to one or two degrees. Furthermore, the factors cannot be applied near coastal boundaries, due to the lack of uniformity in the wind systems, the presence of gradient currents nearshore, the effect of the tide, and barrier effects of the shoreline. Even so, the implication that the uppermost water moves directly with the wind is significant.



CURVES SHOWING relationship between percent current velocity and water depth.

An interesting conformity with the results of Hughes is found in Tibby's (1957) analyses of hundreds of drift card paths in Santa Monica Bay near Los Angeles, California. The plastic cards were released at pre-selected stations, ranging from three to seven miles from shore at more or less monthly intervals from September 1955 through June 1956. These cards were weighted so that they floated upright with about five inches of their length below the surface, and two inches above. Thus, the wind was virtually ineffective in moving the cards, and their drift represented the movement of at least the upper six inches, and probably the one or two feet, of the sea. The resulting wind factor averaged 2.5 per cent of the wind velocity observed at the Los Angeles International Airport. It is unfortunate that the research vessel, Velero IV, was required to leave the area each time cards were dropped. Whenever observations were made in Santa Monica Bay aboard the ship, and these were checked against those from the airport, neither velocities nor directions were comparable. Directions were usually in the same quadrant, but the velocities were higher on shore in the morning and lower during the afternoon and early evening. It is likely that if wind velocities at sea could have been obtained for the period of drift, Tibby's factor would have been close to the one determined by Hughes.

In a drift card study conducted at Newport from July 14 to September 5, 1958 (Stevenson, 1958), a number of the cards were recovered offshore. These gave most valuable data, for there was no lag time in their recovery. The calculated velocities,

then, should be compatible with the actual current flow of the ocean during the inclusive hours between release and recovery.

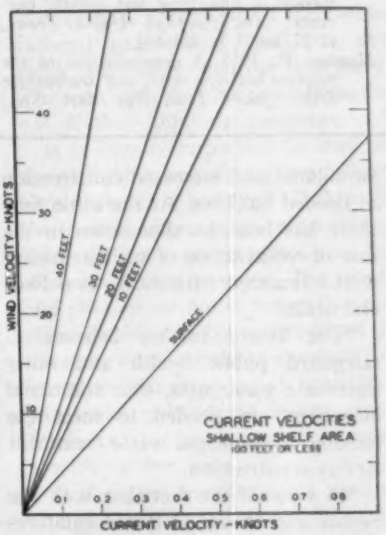
In comparing the highest velocities of the cards with the concurrent winds, we note that when the surface current was 0.2 knot or greater, and the winds greater than 7 knots for two hours or more, the wind/current factor was comparable to those recorded by Tibby and Hughes. However, on several occasions, when the currents flowed at velocities greater than 0.2 knot, the winds were blowing at only from 1 to 6 knots. Obviously, the wind/current factor was much higher than 3.0. From this we must assume that in some areas forces other than the winds can generate currents with significant velocities. These forces are noted in the absence of brisk winds, but need not be restricted to such periods. More likely, winds of sufficient velocity override the forces. As an example, morning winds on August 26, 1958, were slow, but a current of 0.22 knot was flowing *toward* shore. Later in the day, when the wind velocity increased to 10 knots, a current of 0.27 knot flowed *along* the coast; *with the wind* (Stevenson, 1959).

From these three investigations involving the uppermost surface of the sea, it is believed that one can reasonably consider the upper six-inches of the ocean over an open shelf to move more or less directly down wind at a velocity of 2 to 3 per cent that of the wind. This is, of course, after steady state conditions have been reached.

Subsurface Motion:—Bowden measured wind currents in the North Atlantic by towing electrodes through rectangular courses. By this method he considered that the water motion in the upper 50 fathoms was measured. During a radical wind shift, when wind velocities ranged from 18 to 30 knots, the current direction changed and became steady within three hours, and never exceeded 0.3 knot. The magnitude of the drift was about 1 per cent of the wind, speed, and 18 degrees to the right of the wind direction.

When considering water motion over the shelf below the surface layer, the work of Stewart (1956) and by the Staff at the Hancock Foundation in 1955-56 is most applicable. Stewart worked generally in water less than 100 feet deep. The drift studies by the scientists at the Hancock Foundation were conducted in deeper shelf waters. In each case the techniques were similar. Both groups used surface and subsurface drogues, which were followed for rather short periods of time (1 to 10 hours), and the drogue positions were accurately determined. Observations of wind and water temperatures were gathered during the times of drift.

Surface and subsurface drogues were released from the Velero IV in Santa Monica Bay in the spring and summer of 1956. The computations made by the writer from the data in the subsequent report (Stevenson, Tibby, and Gorsline, 1956)



CURRENT/WIND diagram for determining shallow shelf area current velocities.

show that at a depth of 15 feet the average current/wind factor was 2 per cent, and at a depth of 50 feet the factor was 1.4 per cent. The drogues were all released in 300 feet of water, some seven miles from shore in the center of the bay. All drifted more or less shoreward, and as they were in the water between 0900 and 1600 hours, the sea breeze was the main motive force.

Several score drogue paths were plotted from the year's study conducted by Stewart in the shelf waters off Point Loma and Imperial Beach near San Diego, California. Drogues were released in groups with at least one surface float and another below the thermocline at an average depth of 5 to 60 feet. Because the depth of water at the release point was usually 100 feet or less, many of the subsurface drogues grounded nearshore. The average current/wind factor at Point Loma was 1.4 per cent, and at Imperial Beach, 1.3 per cent. Subsurface currents were also lower in the latter area, where at a depth of 40 feet the factor was 0.4 per cent. In the waters off Point Loma the water at 50 feet had an average velocity of 0.6 per cent that of the wind.

Both sets of data are quite reasonable when the oceanographic and geographic conditions in the two areas of investigation are taken into account. In Santa Monica Bay the drift paths were always in water deeper than 100 feet, four to seven miles from shore, and progressed shoreward. As would be expected the velocities in nearer shore areas are less than those farther offshore. Drift angles also differ. In Santa Monica Bay drift in the upper layers averaged 18 degrees to the right of the wind. Whereas, in the San Diego area the average was 44 degrees at Point Loma and 39 degrees off Imperial Beach. In both velocity factors and drift angles, the barrier and deflective effect of the coast on nearshore water movement is clearly shown.

In Figure 1 the data considered have been plotted and two best fit curves drawn. There is no assurance that these curves should parallel each other or that they are straight line functions between 2 and 50 feet. Nevertheless, their application to currents and winds in the shelf area of southern California has been confidently made when the direction of air flow is judicially considered. For example, winds blowing from the east, southeast, or south can develop velocities noted from the lower of the two curves. Such winds will normally result in a current directed shoreward and the shoaling bottom and barrier effect of the shore result in reduced velocities. Winds from all other directions result in velocities noted from the upper curve. To facilitate determinations, a current/wind diagram is presented in Fig 2.

Resume

Over the mainland shelf of southern California where the major water movements of the ocean dissipate, or

enter the area infrequently, the wind attains a dominant roll in moving the water, especially the shallow wind drift.

The wind exerts its greatest influence on the surface of the sea so that here the current flows at an average of 2.5% of the wind velocity. No deviation of current direction from that of the wind usually occurs, except in the very nearshore region where the shore influences both the direction and velocity of the water flow.

The effect of the wind is readily apparent to depths of 50 feet, but the reaction of the water to the air stream decreases appreciably. Wind/current factors average 1.3% at 20 feet and 1% at 50 feet.

Over a wide shelf the wind, undermost conditions, is the significant factor in developing currents. Primary and secondary effects of the tide are important in certain areas. These latter forces must be determined by detailed surveys, whereas a general concept of the wind's influence may be gained by the use of wind data alone.

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Hawaii Looks To Future of Water Supply

A $12,500,000 water system construction program covering the next six years was presented to Honolulu city officials by E. J. Morgan, the chief engineer and manager of the Board of Water Supply.

His proposal recommends that $5,-169,000 be spent this year so that: "an agressive and greatly stepped up program covering many areas of Ohau must get under way at once if serious water shortages are to be avoided.

Water Pollution Control Advisory Board Adopts Resolutions

At the conclusion of a two-day meeting in Washington on January 19 with Secretary Arthur S. Flemming and officials of the Public Health Service, the Water Pollution Control Advisory Board to the Surgeon General adopted the following resolutions:

"The Water Pollution Control Advisory Board, after careful analysis of the Construction Grant program for municipal waste treatment works to control water pollution, as authorized by Section 6 of the Federal Water Pollution Control Act, believes that these grants have significantly stimulated and increased construction of needed facilities. At the same time there has been no slow-down in the rate of construction of such treatment works financed entirely by non-Federal funds.

"The Board further believes to safeguard public health and other legitimate water uses, that additional incentives are needed to meet the backlog of municipal waste treatment facility construction.

"In view of the fact that both the Senate and House of Representatives of the Congress of the United States have passed bills authorizing the increase of such construction grant funds and in view of the possibility that a bill to accomplish this result may soon be passed by the Congress and sent to the President for signature, the Board urges the Secretary of Health, Education, and Welfare to support approval of the bill.

"In view of the increased discharges of new products and wastes, as well as problems caused by population and industrial growths and increased urbanization, the Board recommends the establishment of additional cooperative State-Public Health Service basic data stations. A sufficient number should be established to provide information on the quality of our Nation's water so as to enable States, localities, industries, and the Federal Government to protect the public health and conserve such waters for public water supplies, propagation of fish and aquatic life and wildlife, recreational purposes, and agricultural, industrial, and other legitimate uses."

Griffith & Griffith Change Address

L. B. Griffith and C. C. Griffith have announced that they have moved to a new location. Their present address is: The Anderson Building, 450 W. Broad Street, Falls Church, Virginia.

Daniel J. Hennessey Dies

Daniel J. Hennessy, 76, former President and Director of the Jamaica Water Supply Company, a utility serving Eastern Queens and Western Nassau, Long Island, died recently at Dallas, Texas where he had lived for the past several months.

Mr. Hennessy was President of Jamaica Water Supply for 13 years until his retirement at the end of 1958. Before that, he was Associate Controller of the Long Island Lighting Co. He had also been an officer of a number of public utilities in the Southwest under the management of Stone & Webster and an officer and director of various utilities in Pittsburgh, Pa.

Dear Bill: How do you handle a meeting?

Please pardon my delay in answering your last letter but there has been just one darn meeting after another. During this last month it was not as bad however as I was able to handle them better than in the past and get things done the way I wanted. I've been studying this problem quite a lot because it's frequently important to put over something at a meeting in the right way.

You know a certain degree of speaking ability, knowledge of what one is talking about, self-confidence and polish are desirable but these assets are not necessary requirements. Even though you or I may lack one or more of the foregoing we can still successfully attain what we are after.

Carefully planning the seating arrangement of the group is one of those minor things. It is, in fact, the most neglected of all. A plan for a meeting should embrace positioning of chairs around a table or desk in such a manner that every individual has an equal position, is able to see and hear whoever is talking and is so situated as to avoid placement of "cronies" together where they can distract one another.

Picking out the most stable personality in the group and seeing that he is seated in a key spot I have always found to be valuable. Properly locating such a person can help to keep the whole meeting in line. Greeting such an individual when he enters the room and steering him to the particular seat where he can exercise this influence will pay off in the long run.

Another bit of pre-meeting planning is to have someone to bring out your ideas for you and steer discussions along the lines desired. This may sound a bit crude but when we have developed the thinking processes of such an individual along our own lines before the meeting ever starts, we have such assistance whether or not that person knows our plan of action.

How we conduct ourselves during such a group meeting can make or break the program. Above all we must stay level headed. This permits us to adhere to our previously established program. Remaining unruffled regardless of what happens is not always an easy thing to do but it is essential in controlling group discussion.

Having a plan is also important. Too many of us go into a meeting with only a general idea of what we want to do. We must never forget that people, regardless of their educational or cultural level, do not think any more than is necessary. The man with the plan saves them the use of their thinking processes.

It is equally important to stick to the plan. If it was a good one beforehand it is still a good one all through the meeting. Permitting arguments to deter us from our program can destroy the whole program. The words and phrases we use in presenting our plan should also be programmed in advance. Each should be carefully selected so that in so far as possible it will make each person in the group think that the ideas being presented are his or her own.

It also pays to adhere to a positive line of thought at all times. The others can tell when we have confidence in a program or an idea and when we don't. All of us have a very definite tendency to follow confidence and to shy away from indecision of any kind or type.

I find it pays to state the problem or procedure desired in clear and easily understood terms and to get the people in the meeting to restate it themselves in their own words. Ask them for a solution even though the answer is obvious to everyone. Action always follows much more surely when the group believes that the solution came from within itself rather than being suggested directly to them.

How we do this is also important. It seldom pays to make a "speech" before a small group or gathering of any kind. Present the facts clearly and to the point; then sit down and let the group discuss what has been offered. Retain control by acting as the discussion leader and see to it that no other member of the group has a chance to assume this role. As long as you are careful to retain the leadership of any discussion one can guide it through to the desired decision. Prodding responses helps to do that and it also enables us to guide questions along the desired direction.

It is seldom wise procedure for us to enter into arguments with the group. Leave the debate to the members themselves. Stay on the same side of the fence all through the meeting.

Objections have to be met; they will always be present. Such objections, unless met and handled can destroy our whole program before we know what has happened. Most of the time these are founded solely on misconceptions or lack of information. It is very important that one never forget every such objection is completely valid in the mind of the other fellow and to treat it with the respect he feels it deserves.

Another step I find profitable is to make a few notes as I go along; notes on what others are saying during the discussion. This has a threefold purpose, it flatters the other fellow, it enables me to use the comment later and it helps direct discussions toward the conclusion I am after.

Finally, one very big factor should never be overlooked. We can be assured that every other individual in the group will be questioning in his or her mind our own self-interest in the proposal. We have to be clear about this.

The foregoing points have helped me a lot in putting over my ideas and programs to all sorts of meetings. I hope you will find them useful.

Yours,

Jack

Editor's Note: Jack is really Mr. Ernest W. Fair of Boulder, Colo.

Meeting in New York for its thirty-second annual meeting was the . . .

New York Sewage and Industrial Wastes Association

EDITOR'S NOTE: Executive Committee of the NYS&IWA postponed any action on a name change for the organization.

THE NEW YORK STATE OXIDATION POND at the Sage installation at Syracuse was described by S. W. Williams, O'Brien and Gere, Consulting Engineers, Syracuse, N. Y. Less than two months were required to construct a two-stage oxidation pond proposed as the temporary solution to the waste treatment problem at the government's installation near Syracuse. The first stage provided 34 days retention while the second provided 198 days. A pumping station and bar screen precedes the pond. Built at a total cost of $31,400, the pond was placed in operation on January 1, 1957 and produced no odors or other nuisances during the year. The shallow depth (15") assisted in mixing.

BOD was reduced 70% by the pond, the second stage of which was never used. Suspended solids removal was also 70%, design being based on a loading of 500 persons/acre. The pond was stocked with small mouth bass and blue gills which have survived.

TREATMENT STUDIES ON LONG ISLAND DUCK FARM WASTES were summarized by C. D. Gates, Dept. of Sanitary Engineering, Cornell University, Ithaca, New York. Duck wastes have a BOD equivalent to weak municipal wastes. A need had been demonstrated for disinfection due to isolation of Salmonella and other enteric organisms from creeks and coves surrounding the duck farms. The absence of bactericidal seawater in these areas make disinfection particularly important. Studies were carried on to investigate the chlorine relationships, chlorine demand, dose and residual coliform density resulting from chlorination. Studies were first started out in the laboratory and were based on doses providing 5, 10 and 15 minutes contact times.

The three basic types of farms, upper lagoon, underwater lagoon, and dry farms showed no significant differences considering chlorine doses required. This was also true for residual coliform density. However, the dry farms use less water, therefore, less chlorine would be required for disinfection.

WASTE TREATMENT at the Poughkeepsie, New York plant of the International Business Machines Corporation was described by J. J. Jefferson, Plant Eng. Div. The Poughkeepsie plant of IBM manufactures electronic computers and includes a separate research facility. Waste disposal is divided into three classifications; sanitary sewage, industrial and laboratory wastes, and radioactive waste. The main plant produces only sanitary and plating wastewaters.

The research laboratory sewage treatment plant consists of a Clarigester, slow sand filters, chlorination for a maximum flow of 30,000 gpd. The main plant has a primary sewage treatment plant with post chlorination and greenhouses for sludge drying. This plant shares an outfall sewer with Poughkeepsie, N. Y. through an outfall into the Hudson River.

Industrial wastes from the main plant are collected in two holding tanks containing 140,000 gallons each. These units are automatically operated on a fill and draw basis to remove sludge prior to discharge to the stormwater sewer joining the sanitary sewer outfall. Flow is measured by means of a Kennison nozzle and its associated recorder.

Research laboratory wastes are diluted and flow to equalizing tanks, the volume being approximately 75,000 gpd. Following equalization, the wastes pass through a limestone contact tank and are mixed with the outfall of the sanitary sewage plant effluent prior to discharge into Casper Kill Creek. Fluorides, chlorides, cyanides and other materials that are extremely hazardous are placed in suitable containers, removed by the maintenance department on request. Hazardous dry powder chemicals are disposed of in bottles or other suitable containers with proper warning identification. Radioactive waste disposal consists of collecting all contaminated materials in containers and disposed of by a special vendor approved by the Atomic Energy Commission. These wastes result

from the use of routine radio'sotopes used in the laboratory.

CHLORINE DEMAND AND CHLORINE REQUIREMENTS of an Industrial Waste-Comparison of Alternative Methods was discussed by M. C. Rand, Middlesex County Sewerage Authority, Sayreville, N. J. and J. V. Hunter, Rutgers University, New Brunswick, N. J. Studies have been conducted of chlorine demand and chlorine requirements to find the best means for use in particular problems when assessing charges against waste contributors. Five methods have been investigated and examination of variable results plus repeatability of each method have been made. Methods have been applied to paper mill wastewaters, using two laboratories in separate locations.

Reasonably good correlation was obtained between standard orthotolodine and bacteriological requirement techniques while the amperometric titrator was reported to show poorer agreement between the laboratories.

In a discussion prepared by H. Marks of Wallace & Tiernan, Inc., the necessity was pointed out of correcting the pH to 2.0 when using the amperometric titrator. This correction will be included in the procedure given in the next issue of Standard Methods. Presence of iron or magnesium requires a pH adjustment to 4.5, which also applies to the colorimetric method.

AN INDUSTRIAL APPROACH TO COMBINED TREATMENT of Industrial Wastes and Domestic Sewage was presented by J. F. Byrd, Proctor & Gamble Co., Cincinnati, Ohio. Proctor & Gamble plants are often located in urban areas where municipal wastewater treatment facilities are available. Some of the advantages listed for combined treatment facilities are (1) savings in first and operating costs, depending on character of the waste and degree of treatment required, (2) lack of available area for primary and/or secondary plants, and (3) specialization requirements where sewage treatment plant operators are ordinarily experienced. Slides illustrated a 1.9 million dollar savings in combined plant versus a separate system of industrial and municipal plant installation for a U. S. community.

The municipality and the industry must realize that a sewage treatment plant has limitations when combined treatment is under consideration. Inflammable materials, for example, should not be discharged nor should toxic wastes detrimental to the sewage treatment plant operation be permitted. Acid and alkaline wastes should be diluted, therefore pH control is mandatory. Facilities should also be provided for the separation and collection of fats, oils and greases.

To determine treatability of industrial wastes in primary treatment plants, settling tests using realistic procedures should be run. Fresh samples should be collected in the field, analyzed for BOD and suspended solids. Plots should be made from different detention times to provide adequate loading figures for sewage treatment plant personnel. Proctor and Gamble laboratories use a settling tube 2 ft. deep by 46" in diameter for test of this type.

If necessary, adequate pilot work should be carried on to determine the probability of success and the degree of tolerance of the sewage treatment plant process for any given industrial waste. Industry should bear its fair share of costs including amortization of the required investment.

LEVELS OF DETERGENTS in Sewage Treatment Processes were discussed by R. M. Manganelli, a paper prepared with H. Orford and C. N. Henderson, Rutgers University, New Brunswick, N. J. The increased production and use of synthetic detergents led to the study of the extent of synthetic detergents in central New Jersey. Seven-day composite samples of waste waters using an automatic sampler were taken. The analytical method selected was a modified methylene blue which showed a 10 to 12.1% removal by sedimentation plants, 48.3% by trickling filter plants and 29.5% syndet removal by activated sludge plants. The amount of synthetic detergent in sludge was found to be 0.33 to .94% of dried solids for primary sedimentation plants and 1.3 to 1.38% for sludge from secondary sedimentation units. Approximately 50% of syndets going to the sewage treatment plant are being discharged into receiving streams.

SEWER INSPECTION Using Photographic Methods was described by V. L. Packard, Niagara Falls, New York. Difficulties in examining a rock tunnel located in an L-shaped, flat tableland in Niagara Falls have been partially solved by portable color photographic equipment. Constructed in 1912, the rock is unlined and located 60 ft. below the street surface and parallel to the Niagara River upper gorge.

Visible stoppages occurred and inspections were complicated by the presence of toxic wastes. While the wastes vapors tend to destroy the color film sensitivity, sufficient evidence was obtained to locate areas requiring repair and provide a record of the tunnel's interior.

TEN YEARS OF WATER POLLUTION CONTROL PROGRAM in New York State was presented by A. F. Dappert, N. Y. State Pollution Control Board, Albany, New York. The N. Y. Water Pollution Control law is 10 years old. The law is designed to prevent new pollution and abate old pollution and in doing this the control board handles 900 plans per year for approval. Among the old problems which have been solved or are being solved are Lake Erie and the Niagara River where added sewage treatment plants have been constructed. Phenols, toxic wastes and suspended solids have been greatly reduced. Duck wastes resulting from the 40 to 50 year old industry on Long Island now receive alternating lagoon treatment which has permitted reestablishment of the oyster industry in Great South Bay. At Chatauqua Lake, N. Y. septic tank discharges have interfered with resort and fishing centers.

The county health engineer has made progress in eliminating pollution sources and the village of Mayville erected a sewage treatment plant. At Onandaga Lake, Solvay Chemical has relocated its disposal lagoons and will conduct domestic sewage to a sanitary sewer for treatment. Rochester also has a new sewage treatment system.

OPERATION OF SEWAGE TREATMENT PLANTS of the N. Y. State Thruway Authority was described by I. P. Sander, N. Y. State Thruway

Authority, Albany, N. Y. Four test sites were located along the N. Y. State Thruway at service station—restaurant areas, the most remote being located 111 miles from Albany. Pneumatic flow recorders were installed using bubble pipe and 90° weir. Bottled CO_2 and a pressure reducing valve served as a pneumatic pressure source.

Samples were composited and suspended solids, B.O.D. and grease determinations carried out. Maximum flow determinations indicate that no plant was overloaded, the design being based on 16 hr. rates. Flow recorders carried an erratic pattern depicting periods when bus passengers were visiting the stations. The trickling filter stations show B.O.D. and grease reductions exceeding 90%. Primary plants show inconclusive results, but low efficiencies were the case during the sampling periods.

Operating Experiences With Small Sewage Treatment Plants at Small Isolated Military Installations were reported by W. Wechter, First Army Headquarters, N. Y., N. Y. Systems described are located at Nike sites each consisting of two separate areas. One area for administrative purposes and control and another location where the missiles are launched. These sites originally used septic tanks and tile fields but trouble developed from grease, soil clogging and poor maintenance. Failures led to the allocation of 2.5 million dollars for a replacement program. Three types of 2-stage biofilter plants were selected as a basis for final design in the replacement program. Dry digested sludge is used for soil stabilization, fill and embankments on the site.

The use of mechanical equipment involves a regular maintenance program conducted by civilians living off the site, civilians living on site, Army sanitary engineers, government employed civilians or post enlisted personnel. The enlisted personnel may resent this type of work and the best operation is probably by government employed civilians who are more permanent and can be trained to do the specific job required. Overall B.O.D. removal is greater than 90% with suspended solids removal of 85% found as result of surveys by the Army's environmental health laboratory.

Operation of High Rate Digesters at the Jamaica Sewage Treatment Plant of New York City was described by N. Nash, Dept. of Public Works, New York, New York and H. Chasick also of the Public Works Dept., New York, New York. Studies were carried out for 18 months using high rate digester operation to determine design criteria for new construction. During the study, sludge was thickened and pumped to 80 ft. diameter digesters modified to include fixed covers, 7500 gpm mixers having 21″ blades and 23″ diameter draft tubes, gas take-off, gas meters, equalizing tank, vacuum relief valves and glass-covered viewing windows proving very helpful in later phases of the study.

The work was completed in 1958 and in June of 1958 the digesters were filled with digested sludge. Raw sludge was added slowly until the limit of loading was reached. Tables showed 10.6 days detention versus 18 days for the comparative standard digesters. Loading comparisons were 0.45 and 0.27 pounds per day per cubic foot of digester and .34 and 0.21 pounds per day computed from the digester volatile loading. No scum accumulated on the digester tank surface during the test.

The studies led to a design criterion based on .25 cubic ft. per pound per day for solids loading rate. Additionally, toxic industrial wastes must be eliminated from the plant collecting system.

DeLaval Whey Protein Process was described by H. Wall, Graco Dairy, East Aurora, N. Y. and W. W. Pinckney, DeLaval Separator Co., Poughkeepsie, N. Y. Recovery of protein from whey resulting from cheese manufacture involved an approach based on utilization and reclamation of such portions as possible. All the whey was previously discharged to waste, no attempt being made to recover any materials.

The present system using centrifugation, permits reclamation of butter from the whey and condensation of the whey to produce animal feed supplement. The waste treatment problem resulted from mergers of dairy concerns which centralized the dairy industry and caused a larger localized problem. Lagooning the wastes produced odors and made this means unsatisfactory for disposal.

The technique finally evolved utilizes fresh low acid whole or skim milk whey at the rate of 25,000 gpd under 25″ of vacuum for gas removal. Following heating to 180-200° F. lactalbumin is precipitated and organisms are killed. Twenty minutes standing and addition of food grade acids complete the precipitation.

The whey is centrifuged to concentrate the precipitate which contains 70% protein. This is used as a stock feed and the liquid is used for irrigation. BOD of the whey on the municipal sewage treatment plant has been studied in a preliminary manner. The results are encouraging, but the work is continuing.

Experimental Treatment of Cottage Cheese Whey-Bearing Wastes was reported by W. T. Ingram of New York University, N. Y., N. Y. Studies were carried out at the Dutch Hollow Foods Corp. a medium sized milk producing plant in up-state New York. The plant discharges contributed a nuisance in receiving streams. The plant operates 23 hours per day, ordinarily for 6 to 7 days per week, producing butter, cottage cheese, ice cream mix and condensed milk.

Two previous studies analyzed the wastes and gave information on municipal waste treatment plant operation before and after operation of the food plant. Pilot plant studies were carried out in 1957 based on two 10 ft. column filters containing stones and a provision for recirculation from one column to the other, plus facilities for blowing air upward counter-current to the waste flow.

Wastes were pumped to the towers from a holding tank. Column loadings were on the order of 99.8 to 299.5 mg/acre/day. Pilot studies showed no need to recirculate the wastes. The resulting effluent discharged to the municipal sewage treatment plant improved solids removal and B.O.D. reduction.

Water Works need suitable methods for . . .

Practical Corrosion Testing

by WILLIAM E. KIRKENDALL, Water Distribution Division, Los Angeles, Calif.

EDITOR'S NOTE: The author reports some results of his search for practical methods of corrosion testing. Since Southern California has had particular difficulty with dissimilar metals corrosion of gates and valves, it became necessary to devise practical methods of testing metals or combinations of metals to find those best suited for use in the water distribution systems.

The suspended test rack and corrosometer are suggested as techniques for evaluating metals under conditions of exposure most similar to those in the city mains.

The author reports a lack of information from the literature and solicits assistance or the exchange of knowledge with any reader who would care to correspond.

■ DEZINCIFICATION of brass gate stems and dissimilar metals electrolytic cell corrosion of metals and alloys used in the fabrication of water works gates and valves have caused problems and failures in water distribution systems in the Los Angeles area of Southern California. The problem has become more apparent upon the extensive use and mixing of partially softened Colorado River water with local sources of supply. The Colorado River water, when received, has an electrical conductivity of approximately 1230 ($K \times 10^6$) mhos or 800 ohms /cm^3 resistivity which classifies it as a very corrosive water.

The Corrosion Engineering Section of the Los Angeles Water Distribution Division was asked to determine which metals or alloys would be most suitable and economical for use as gate stems, bushings, gate seats, rings and other parts or fittings where failure of water works structures had occurred. To accomplish these ends it was necessary to establish methods for evaluating operating experience and to devise test procedures to obtain data both in the field and in the laboratory.

Dissimilar metals corrosion cell couples were the most serious contributors to failure in the distribution systems. In addition to having required mechanical strength, combinations of metals had to be found for use in places where dissimilar metals could not be avoided.

Laboratory testing methods had to measure not only the corrosion resistance of various metals and alloys used but also their corrosive effects on adjoining structural metals or those in mutual contact with corrosive aqueous solutions. Sensitive electrical measuring instruments would be required for such testing. The main objective, however, was to develop simple tests which could be conducted on laboratory built equipment and would provide the practical information needed.

Since natural waters are not similar, it was found that the use of tables on the "Galvanic Series" of metals and alloys are not entirely applicable to each particular water. Many of these lists and tables are compiled from data obtained with aqueous solutions of electrolytes which don't conform to the character of water used in Southern California or to the particular environment in which these water works structures are exposed.

Electrolytic Couples

The self corrosion of metals and alloys results from micro-cell electrolytic couples in aqueous solutions. The dezincification of brass and deferrization of cast iron are typical well known examples. The loss of structural strength results from the corrosive action caused by the dissimilar components in the matrix of the metal which form minute anodes and cathodes both mutually in contact with the aqueous solution of electrolytes. The corroded structure becomes honeycombed with deposits of corrosion products and the original sound metal becomes spongy and porous, and eventually loses most or all of its mechanical strength.

Brass gate stems and other parts are particularly susceptible to dezincification when exposed to waters with a high content of ionized dissolved salts, especially sodium, chloride and sulfate. Colorado River water is such a solution of electrolytes, and dezincification of brass is a common experience with water works operators delivering Colorado River water through their distribution mains.

A practical and inexpensive exposure test can be made on metals or alloy compositions to determine their susceptibility to micro-cell electrolytic corrosion. This simple test as indicated in Figure 1 can be used to screen

out specimens showing least immunity to corrosion. The remaining specimens exhibiting desired characteristics can be subjected to more exacting and selective tests.

Stress Corrosion

Multiple tests on behaviors of metals and alloys with respect to stress corrosion under strain and periodic reversals of application of torque, such as water works gate stems are subjected during actual operations of opening and closing gates, will indicate those least susceptible to failure by progressive fracture; and micrographic examinations will show the effects of corrosion penetration into minute cracks and crevices developed under tension and/or repeated reversals of application of torque.

Cross-sectional penetration of specimens by progressive fracture will be accompanied by decreases in electrical conductivity along lengths of the specimens, and loss of metal by corrosion will also be accompanied by decrease of electrical conductivity. Loss of weight of metal by corrosion will be a measure of the average corrosion penetration per unit of surface area of the specimen exposed to contact with solutions of electrolytes. Using test specimens having dimensions indicated in Figure 2, the values obtained by test will be given and recorded as c.g.s. units of loss of metal by corrosion in milligrams per square decimeter per day (m.d.d.), which is a widely recognized and used standard of corrosion measurement.

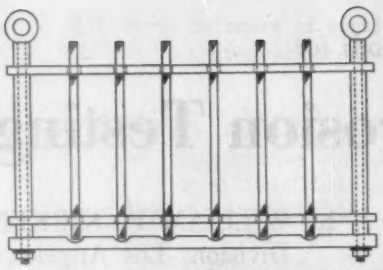


FIG. 1. PLASTIC TEST RACK held together with two long coated eye bolts will support 6 metal specimens shown in center.

Adjacent baser metals

In addition to being themselves relatively immune to micro-cell corrosion attack, dissimilar metals and alloys used for water works gate stems and other parts should be tested to determine which combinations in completed gate assemblies will have least tendency to cause corrosion of adjacent baser metals. For example, bronze gate stems and gate seat rings will be cathodic to cast iron or steel and the baser metals will suffer anodic corrosion in the dissimilar metals electorlytic cell couples formed by their mutual contact with aqueous solutions of electrolytes.

The degree of tendency of any combination of metals and alloys to cause dissimilar metals electrolytic cell corrosion of adjoining baser (more anodic) metals can be measured by connecting the anodic and cathodic metals in external circuit through sensitive electrical measuring instruments, with the electrolytic or internal circuit closed by mutual contact with solutions of electrolytes such as they will encounter in actual service use. The potential differences indicated by sensitive electrical measuring instruments will be a measure of the tendency of that particular combination of dissimilar metals to cause corrosion of the more base or anodic metal. The most desirable combination of dissimilar metals used in water works gate construction would be to have the gate stems, gate seat rings, etc., slightly (but only slightly) cathodic to adjacent baser metals. Metals and alloys are available which are not so widely separated by electrolytic potential difference as are some of the bronzes from cast iron and steel at present used.

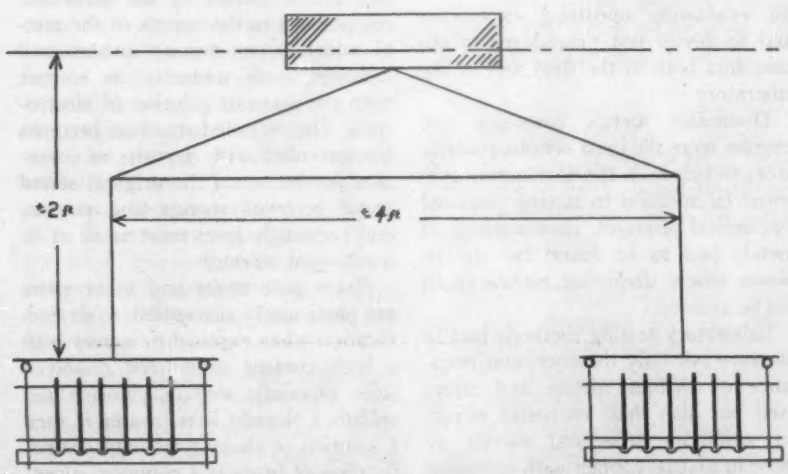


FIG. 2. ARRANGEMENT of Test Rack Suspension from buoy at water level. Four specimens of each competitive material are required. One unexposed comparison sample and 3 test specimens, 1 each for 3 periods of test exposure.

A. For dezincification and/or micro-cell self corrosion no other specimens needed.

B. For tests on dissimilar metals coupling effects, specimens may be electrically coupled to weighed rods or bars of the baser metal suspended from near hub of wheel spokes.

C. For weight loss of baser dissimilar metal, 1 coupled and 1 uncoupled weighed specimen of the baser metal are required. Baser metal specimens should have greater surface area of exposure than noble metal specimens.

Proposed Corrosometer

Water works operators have some problems of practical testing and measurement of dissimilar metals corrosion caused by metallic contact and electrolytic cell coupling of bronzes and other metal alloys used for gate stems and other parts of water works gates and valves with the steel or cast iron of which gate bodies and disks are made.

The preliminary design for testing and measuring relative effectiveness of various dissimilar metals and alloys used in water works gate and valve construction for mitigation of dissimilar metals corrosion problems has been evolved from a combination of the Thin Section Tests described by E.S. Hedges of Cambridge, England with practical considerations of economical applications of the corrosometer described by Albert W. Bruce and Ben C. Albritton of the Pacific Gas and Electric Company.

Tests and corrosion measurements applied to thin sections of the various metals and alloys considered for

use in gate and valve construction would be practical, economical and directly comparative. They can be made to show corrosion losses resulting solely from attack upon the various metals and alloys by aqueous solutions of electrolytes, under conditions of stress and torque imposed by normal operations. By coupling them with the baser metals of gate body construction, the effects of dissimilar metals corrosion cell couples can be measured. With data obtained by such tests, selection of the most suitable metals and alloys for a particular use can be determined.

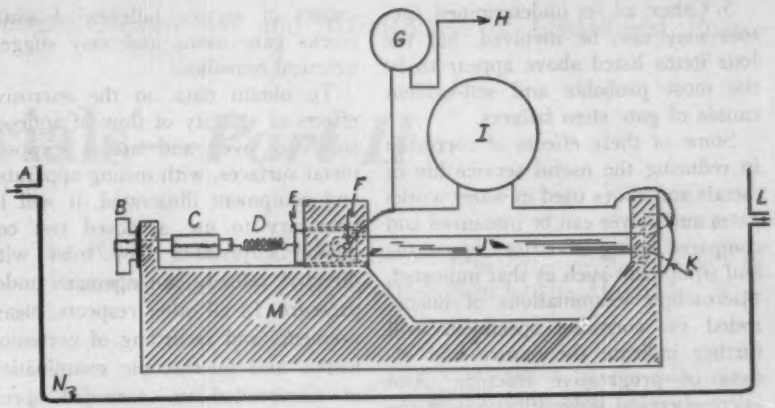


FIG. 3. PROPOSED ADAPTIONS to Pacific Gas & Electric Corrosometer for water industry corrosion measurements.

A. Adjustable flow inlet
B. Tension adjuster
C. Tension guage
D. Tension spring
E. Electrically insulating non-rotating tension slide
F. Metal pin
G. M.V. meter
H. To coupled dissimilar metal
I. Wheatstone bridge type electrical conductivity meter
J. 10 cm x 0.4 cm x (t-)/mm specimen
K. Electrically insulating torque applicator (Rotate ¼ turn, right or left, every 24 hours)
L. Overflow outlet
M. Plastisol coated tension-torque test specimen holder
N. Pyrex glass immersion test cell

Test Specimen Size

Test data on corrosion losses vs. time of exposure and service use can be directly translated into units of corrosion penetration or weight loss of metal per unit of time, as m.d.d. (a standard referred to above). Loss of weight by corrosion of a thin metal section measuring 10 cm x 0.4 cm x 0.01 cm will be the weight of metal corroded from 10 sq cm of metal surface exposed to corrosive attack, which is 1/10th of a square decimeter.

By calculation, if:

A = cross-sectional area of the test specimen, and
T = tension to be applied to the specimen (in lbs.);

Then the thin section specimen having dimensions of 10 cm X 0.4 cm X 0.1 cm would have an:

A = 0.4 x 0.1 = 0.04 sq cm
or since 1 sq. cm = $(0.3937)^2$ = 0.155 sq inches, then
A = 0.04 x 0.55 = 0.0062 sq inches.

By applying a one pound tension spring to such a small specimen would then make:

$$T = \frac{1}{0.0062} = 1613 \text{ psi}$$

These thin section dimensions have been tentatively selected as standard test specimens because they give measurements of loss of weight by corrosion directly in terms of c.g.s. units of m.d.d. (milligrams/sq dm/day). If tests are conducted for a period of 10 days, milligrams loss of weight of metal by corrosion will be the average m.d.d. This value can then be converted to IPY or any other standard units desired. Other dimensions of test specimens are adaptable and may be used when necessary or desirable, but they would involve use of constants and correction factors.

The tension spring indicated in Figure 3 is to permit application of torsional stresses, which are characteristic of water works gate stems in service use and operations. Seldom will it be necessary for the value of T to be more than a few pounds. The exact values are not critical for practical purposes.

Comparative Information

To make any laboratory test indicative of practical service performance, it is necessary that conditions imposed by the test shall (so far as possible) simulate conditions of exposure to which the metals tested will actually be exposed in service use. In the case of water works gate stems, the metals or alloys of which they are made should be placed under conditions of tension, torque, and exposure to corrosive attack not unlike those which they will encounter in water works operations. This has been carefully considered in preparing the Figure 3. The conditions of tension and of reversal of torque indicated are designed to impose strains and stresses simulating those encountered by gate stems when repeatedly opening and closing water works gates. They impose conditions leading to progressive fracture, often referred to as "fatigue failure."

Microscopic and micrographic studies of dissimilar metals failures in service have indicated that in many instances failures were a result of "progressive fracture" combined with corrosion penetration into the microscopic ruptures, and deepening of so-called "fatigue cracks." Service failures of water works gate stems appear to be caused by combinations of all of the following deteriorating effects:

1. Direct corrosion attack upon the metal or alloy used.

2. Micro-corrosion cell electrolysis of electro-chemically dissimilar crystal constituents of the alloy matrix.

3. Progressive deepening and enlargement of minute cracks and crevices initiated by strain and torque stresses applied to the gate stems by intermittant operations of opening and shutting gates.

4. The effects of deposits (microscopic in size) of corrosion products in the cracks and crevices (and of occluded gases and vapors, as well as their liquid solutions) such deposits acting as fulcrums to further deepen stress cracks developed under tension and periodic reversal of torsional stresses applied to gate stems by operations of opening and shutting gates. This is what Dr. Donald S. Clark of Cal Tech describes as "Progressive Fracture" replacing the term "Fatigue Failure."

5. Other, as yet undetermined, factors may also be involved, but the four items listed above appear to be the most probable and self-evident causes of gate stem failures.

Some of these effects of corrosion in reducing the useful service life of metals and alloys used in water works gates and valves can be measured and compared, using laboratory apparatus and equipment such as that indicated. Microscopic examinations of uncorroded vs. corroded specimens will further indicate the nature and effects of progressive fracture. And micro-chemical indentifications of the corrosion products deposited in the stress-produced cracks and crevices, and on metal surfaces exposed to corrosive attack, (using the methods of chemical microscopy) will suggest or indicate the nature and behavior of causes of service failures of water works gate stems and may suggest practical remedies.

To obtain data on the corrosive effects of velocity of flow of aqueous solutions over and across exposed metal surfaces, with testing apparatus and equipment illustrated, it will be necessary to use a closed test cell having adjustable flow inlet with directed velocity impingement under pressure. In all other respects, measurements and recording of corrosion losses, and microscopic examination of uncorroded vs. corroded specimens, will be the same as with tests indicated by Figure 2.

Conclusions

The corrosion of metals and alloys presently used in the manufacture of water works gates and valves have been the source of problems and distribution system failures in the Southern California area. Dissimilar metals corrosion has been the cause of the most serious failures.

There must be some practical way to test metals or combinations of metals under the conditions to which they are to be used. Such testing would identify the best suited metals for each use.

The suspended specimen test rack and the corrosometer have been described as tools for use in testing metals under conditions imposed by local conditions. Other devices and survey methods are probably in use by the water works industry although very little on this subject has been reported in the literature.

Bulletin on Safe Handling of Chemicals

"Health Factors in Safe Handling of Chemicals," is the title of the new publication developed as a part of the activity of the Manufacturing Chemists' Association's General Safety Committee. The four-page publication is designed to help the non-chemist in various plants to become familiar with toxicological terminology, to understand ways by which noxious substances enter the body and exert their harmful effects, and to know the basic principles of first aid treatment.

The new series of guides will cover aspects of safety in chemical manufacturing which are not dealt with in the widely used chemical safety data sheets, also published by the Association. The second guide in the series, which will be published in the near future, will deal with "good housekeeping" in chemical manufacturing. Others are planned to cover such matters of broad application. Safety organization, precautions against environmental hazards, fire, safety training also are possible topics.

The Association's safety data sheets, safe handling manuals, and other activities of the General Safety Committee are credited in the chemical industry with contributing much to the establishment of an enviable safety standard. The 1958 industry record of 2.98 injuries per million man hours worked is far below the record for all industry. It is anticipated that figures for 1959 will be available soon.

Copies of Safety Guide SG-1 are available at 15 cents each from the Manufacturing Chemists' Association, Inc., 1825 Connecticut Avenue, N. W. Washington 9, D. C.

Proposed Commercial Standard On Polyethlene Pipe Approved By SPI

A proposed Commercial Standard on flexible polyethylene pipe, incorporating minimum wall thickness requirements, as unanimously approved by the Thermoplastic Pipe Division of the Society of the Plastics Industry, Inc., at its quarter year conference held in theFairmont Hotel, San Francisco. The Division includes 52 pipe and fittings manufacturers.

In making the announcement of this action taken by the group, George C. Anderson, Division Chairman and Manager for Product Development, National Tube Division, U. S. Steel Corp., said that the document covers three types of polyethylene pipe—depending on the derivative of the base resin in the pipe compound. These include Type I (0.910 to 0.925 specific gravity—CM^3); Type II (0.926 to 0.940 specific gravity—CM^3); and Type III (0.941 to 0.965 specific gravity—CM^3), for low density, medium density and high density material respectively.

The proposed Standard covers one schedule and two series of polyethylene pipe including dimensions or Schedule 40, Series 2 and Series 3 polyethylene pipe.

The proposed Standard also contains a number of performance requirements including a sustained pressure test and an evironmental crocking test. It has now been forwarded to the commodity standards Division of the U. S. Department of Commerce where it will shortly be established as a revision to the existing polyethylene pipe Standard CS 197-59.

The facilities at the National Sanitation Foundation Testing Laboratory at the University of Michigan, Ann Arbor, Michigan, have been increased to handle the physical as well as the toxicological testing of all types of thermoplastic pipe to ascertain if these products conform to all requirements of the existing commercial standards as well as the rigid conditions of the National Sanitation Foundation in regard to suitability of plastic pipe for the transportation of potable water.

The group will continue to be concerned with extensive code work in an endeavor to have plastic pipe incorporated in additional state and municipal plumbing codes throughout the country. This activity is carried on by the Plastic Pipe Research Council, whose Chairman is George C. Reed, Manager, Plastics and Chemicals, American Hard Rubber Company, Division of Amerace Corporation.

The SPI Thermoplastic Pipe Division is immediately undertaking the preparation of a comprehensive engineering manual on all types of plastic pipe including installation techniques and recommended suitable applications.

Part 20 of this series on the Design, Construction and Maintenance of Centrifugal Pumps continues the subject of . . .

Pump Materials—*Part II*

by IGOR J. KARASSIK, Consulting Eng. and Manager of Planning Harrison Div., Worthington Corp., Harrison, N. J.

EDITOR'S NOTE: This second of two parts on pump materials discusses liquid characteristics affecting selection of metals for use in centrifugal pump parts and the effect which structural features of certain pump parts, as well as load factors, may have on material selection.

Part 20, presented here, concludes this series on Centrifugal Pumps. For those interested in obtaining a complete text on Pumps and Pumping, Mr. Karassik has informed us that the F. W. Dodge Corp. will publish a book authored by him sometime late this year. *W&SW* will publish further details concerning this book as they become available.

■ IN ADDITION TO THE FACTORS of temperature and pressure, as well as abrasiveness of any solids suspended in the liquid pumped, there are certain specific liquid characteristics which have a significant effect on the adequacy of any metal or combination of metals that can be used in a centrifugal pump. This last article of the series will discuss these characteristics. It will, in addition outline the effect which structural features of certain pump parts and that of load factor may have on material selection.

Effect of pH

The pH value of a liquid is a quantitative representation of the relative acidity or alkalinity of the liquid. It is based on the concentration of H^+ (hydrogen) ions as opposed to OH^- (hydroxil) ions in the solution. The pH scale is a logarithmic scale, calculated from

$$pH = \log \frac{1}{H^+ \text{ Concentration}}$$

which indicates that the lower the pH, the more acid the solution.

A solution having a pH of 7.0 is neutral; pH values above 7.0 indicate alkalinity and pH values below 7.0 indicate acidity. Because the pH value is expressed in a logarithmic scale, it must be noted that changes in pH represent more than a direct linear change. For instance, a solution having a pH of 5.0 is ten times as acid as one having a pH of 6.0.

The pH of a given solution varies with temperature, decreasing rapidly up to 300°F and remaining fairly constant above that. For instance, a solution with a pH of 8.5 at 70°F will have a pH of about 7.0 at 300°F and 6.8 at 500°F (see Fig. 1).

Although pH is not the only factor influencing the selection of materials of pump parts, standard bronze fitted pumps should not be used for pH values below 6.0 or above 8.5 at the pumping temperature. Below 6.0 all-bronze pumps or stainless-steel fitted pumps should be used; above 8.5, the pumps should be all-iron or stainless-steel fitted.

Effect of Galvanic Corrosion

Galvanic corrosion of a metal occurs when the metal is electrically connected to a dissimilar metal and is immersed in an electrolytic solution. The combination of the two metals connected with each other and immersed in an electrolytic solution is the simplest form of electric battery cell. The electrochemical reaction set up under those conditions causes electric current and small metal particles to flow from one metal to the other. These particles may become deposited on the second metal, or may be washed away due to the flow velocities in a centrifugal pump. The protected metal is the cathode and the corroded end is the anode of the two-metal cell. For this reason, the use of dissimilar metals should be avoided in centrifugal pumps when the liquid pumped is an electrolyte.

If metals are arranged in the order of their relative tendency to corrode through galvanic action, the resulting tabulation is termed a "galvanic series." The galvanic series presented in Table 1 gives an approximate idea of the interrelation of metals most commonly used in centrifugal pump construction. The relative position of the listed metals is subject to some changes. However, changes between adjoining groups of metals are unusual.

Salt Water Pumps

Centrifugal pumps handling salt or sea water may be built with standard fittings, that is cast-iron casings and bronze trim, in all iron, all bronze, or with iron casings and stainless fittings, depending on a number of factors.

Thousands of standard fitted pumps are in use handling sea water, but occasionally that type is not suitable, mostly when the sea water is contaminated, as is the case with harbor waters. Failures are usually due to galvanic action between the bronze parts and the cast-iron casing, which graphitizes and is ultimately a total loss. The galvanic action is accelerated under high suction lift condi-

tions, due to the release of oxygen from the water.

Although an all-iron pump apparently avoids the electrolytic action between bronze parts and cast-iron casings, such action may still occur. A certain amount of iron dissolution may take place, leaving graphitized areas, which perform as cathodes to the untouched anodic parts of cast iron. The resulting galvanic action is self-accelerated. To avoid the graphitization and poor resistance to cavitation of cast-iron impellers, these and other small pump parts may be made of stainless steel.

In general, an all-bronze pump should give the longest life for sea water conditions and instances are recorded of all-bronze pumps lasting more than 20 years handling sea or harbor water. Some harbor waters are contaminated by chemicals that make bronze unsuitable.

Effect of Structural Features

Although in many cases the choice of materials can be made mainly from the point of view of corrosion and abrasion resistance, the structural features of a given pump part may play a definite role in the final material selection. Some parts, for instance, may require extremely thin wall sections, for which a material such as cast iron would be unsuitable, even though it may be suitable from the point of view of corrosion. Other parts, such as shaft sleeves, require a high degree of polish. Obviously, only materials capable of receiving such a finish can be used for these parts.

Wherever the structural design features require the use of pressed-on or shrunk-on parts, the material used for these parts must be suitable for this method of mounting. For instance, when pump impellers have to be shrunk on the shaft, bronze cannot be used and the selection is restricted to cast steel or stainless steel.

One of the important factors in the strength of metal castings is the relative uniformity of cross-sections of various portions of the casting. The more uniform these cross-sections, the stronger will be the casting and the less will be the possibility of internal cracks, inclusions, etc. An example of the inter-relation of structural features and material problems is shown in the construction of double-suction impellers (see Fig. 2). The central hub of double-suction impellers is generally cored out, especially in the case of large impellers, in order to avoid the formation of a heavy cross-section which might lead to porous and imperfect castings.

Table I

Galvanic Series of Metals Commonly Used In Pump Construction

Corroded End (Anodic)

- Zinc
- Iron
- Chromium Iron
- Chromium Nickel Iron
- Tin
- Lead
- Brasses
- Bronzes
- Nickel Copper Alloys
- Copper

Protected End (Cathodic)

NOTE: The series is not complete, as it includes only those materials most commonly encountered in centrifugal pump construction. In addition, it does not include the various stainless steels used for pump impellers, wearing rings or sleeves. The position of these metals in the series cannot be definitely fixed as it has been known to change depending on the exact nature of the electrolyte. It is safe to state, however, that with a weak electrolyte such as slightly acid or slightly alkaline water, they will occupy a position in the iron and chrome iron group and that the galvanic action between these metals is almost negligible.

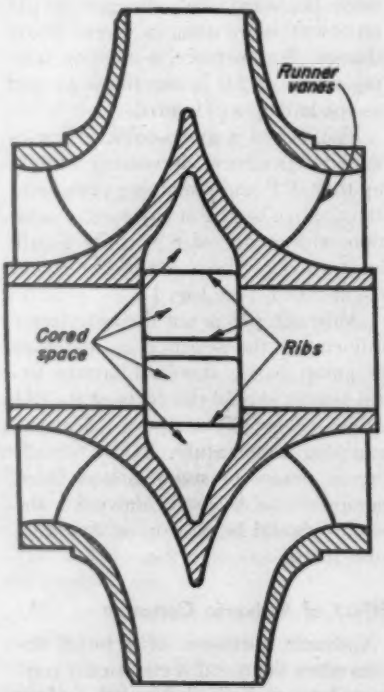


FIG. 2. CORING of impeller hub for foundry reasons.

Effect of Load Factor

It is obvious that the selection of metals that would give the longest possible life for a temporary installation would be uneconomical. Thus, standard fitted pumps may sometimes be applied on a service where corrosion or erosion will wear the pumps out in relatively short time, because the pump would no longer be needed when it is worn out. The same reasoning applies to installations where the pump is operated an extremely small percentage of the time, as long as contact with the liquid pumped during the idle periods does not continue the disintegration process or as long as the pump can be drained and flushed out.

In other words, common sense dictates that the choice of materials be based on considerations of optimum economic life; that is, on the selection of such a combination that the initial cost plus the cost of possible replacement parts and of the necessary labor in replacing these parts yields the lowest over-all total investment during the expected life of the equipment. Thus, in many instances the choice of materials will be neither the cheapest nor the most expensive which may be available.

On the other hand, where outstanding reliability is desired the best materials are none too good, even if a pump is to operate but once in ten years. A good example of this is the pumps used in naval shipboard service. Although operation of the centrifugal pumps on board ship is relatively infrequent in peacetime and not all the equipment installed is operated constantly even in war time, the most rigid specifications as regards materials are enforced because failure of any part of the equipment may prove fatal.

Effect of Metallurgical Advances

There are two fields in which metallurgical advances have had a marked effect on centrifugal pump design. These are the pumpage of chemicals and the handling of boiler feed water. The selection of materials for centrifugal pumps handling chemicals is naturally dependent on the particular liquid in question. This service is a specialized field and one can general-

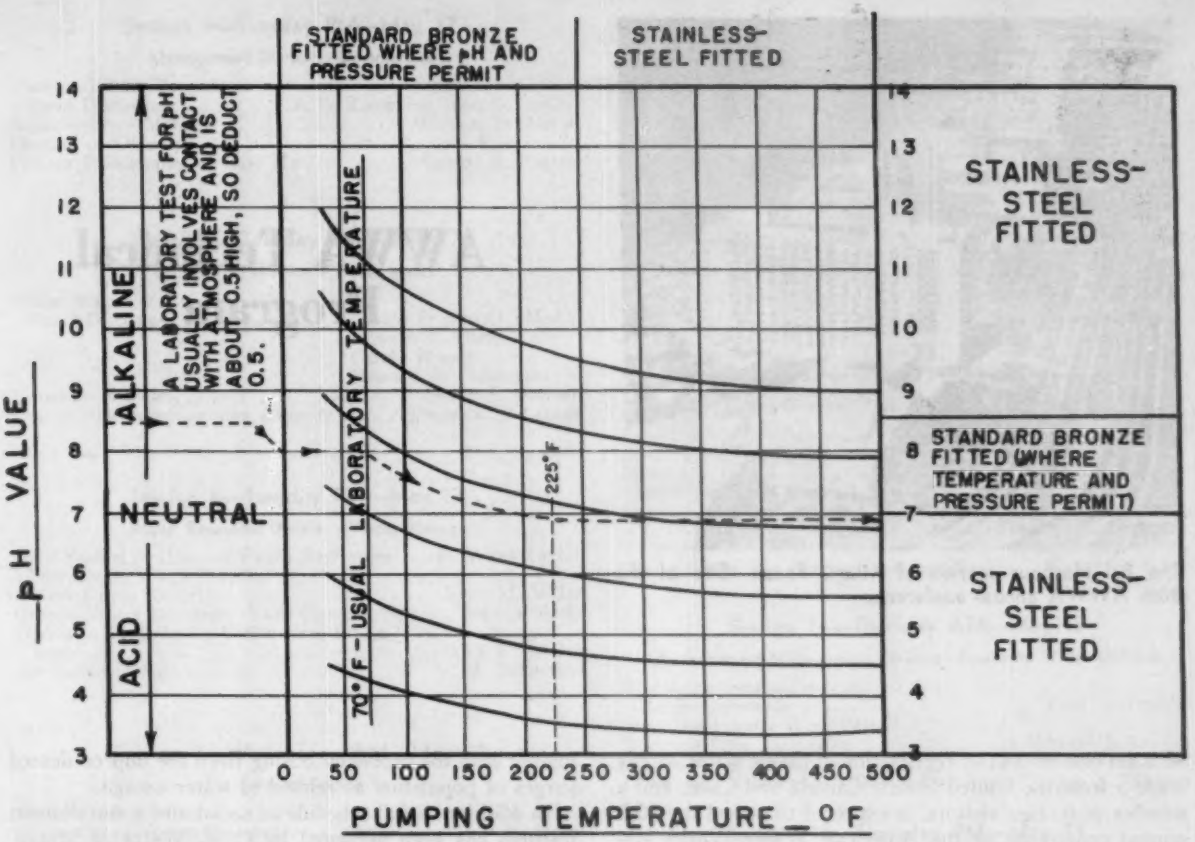


FIG. 1. EFFECT of temperature on pH and boiler feed pump material recommendations.

ly obtain detailed information from the manufacturers actively engaged in production of chemical pumps.

Boiler feed pumps present a more general interest and as the selection of materials for this type of pump has been the most affected of all the general classes of centrifugal pumps by metallurgical developments of the last 15 years, it may be interesting to discuss the present trends in boiler feed pump material selection.

Most boiler feed pumps designed for pressures of 800 psi and above are now stainless-steel fitted, regardless of temperature or feedwater analysis. The use of stainless steel for impellers, wearing rings, sleeves, etc., shows signs of extending to even lower pressures. Today it is almost mandatory under all pressure conditions for temperatures over 250°F and for all installations where the feedwater pH is either below 7.0 (neutral) or over 8.5.

Since approximately 1944, in addition to the use of stainless steels for the internal parts of centrifugal boiler feed pumps, stainless steel casings have been utilized to a much greater extent than before. A definite impetus in this direction had been given by the findings of an investigation conducted by the Boiler Auxiliary Sub-Committee of the Prime Movers Committee of the Edison Electric Institute. This investigation was initiated to determine the cause of the rapid pump deterioration being experienced in many of the higher-pressure power plants, a condition which had reached alarming proportions in the early 1940's. Among the various findings made by this sub-committee was the fact that stainless steels (5% chromium and better) are immune to the attack of any boiler feedwater so far encountered.

The following table has been prepared as a general guide for the selection of boiler feed pump materials:

Generally, straight chromium steels are used, with chromium content at the 5, 9, or 13% level. Austenitic chromium-nickel steels (18% chromium, 8% nickel; or the higher 25% chromium, 20% nickel type) are not practical for boiler feed service. Austenitic steels have a coefficient of expansion approaching that of bronze and 40% greater than that of either carbon steel or of the lower chromium content steels. This difference in coefficient of expansion would lead to operational difficulties if the pump handles hot water.

Casing	Fittings	Max. Temp.	Use
Cast iron	Bronze	250°F	pH neutral to 8.5, unless water is known to have corrosive action.
Cast iron	Stainless steel	350°F	Any pH, unless water is known to have excessive corrosive action
Stainless steel	Stainless steel	Any temp. normally encountered	Any pH and where water is corrosive or previous trouble reported

The Bal Harbour section of Miami Beach—Site of the 80th AWWA annual conference

AWWA Technical Program

■ A RECORD-BREAKING registration of public water supply leaders from the United States, Canada and Cuba, and a number of foreign visitors, is expected to attend the 80th annual conference of the American Water Works Association which will be held in the Bal Harbour section, Miami Beach, Florida, from May 15 to May 20, 1960.

The tentative program for the conference includes two general sessions, fourteen technical sessions and a series of committee meetings that will concern themselves mainly with the problems arising from the unprecedented surges of population as related to water useage.

In addition, a full schedule of social and entertainment features has been arranged by C. F. Wertz of Miami, A.W.W.A. vice president, who is the general chairman of the conference.

Raymond J. Faust, secretary of the A.W.W.A., has announced the following program of sessions that will be held during the meeting.

Session 1—Monday AM—May 16

General Session

President's Address ..... Lauren W. Grayson
Challenges of the Water Industry ..... Raymond J. Faust
Aims and Objectives—Committee Report ..... Fred A. Eidsness
Highway-Utility Problems and Programs ..... Sam Houston

Session 2—Monday PM—May 16

Management Division - Research

Research in the United States ..... Harry A. Faber
Research in Canada ..... Albert E. Berry
Research in the United Kingdom ..... R. G. Allen
What AWWA Should Be Doing in Research—
Open Discussion Led by ..... Thurston E. Larson

Session 3—Monday PM—May 16

Water Resources Division - Ground Water

Quality and Waste Disposal ..... Matthew Irvin Rorabaugh
Recharge—Panel Discussion ..... Richard T. Sniegocki, W. L. Broadhurst, W. Fred Welsch, Robert J. Kleberg, Jr., Richard M. Kleberg, Jr., Frank H. Dotterweich
Salt Water Encroachment ..... Francis A. Kohout

Session 4—Tuesday AM—May 17

Open Session
Water Works Administration Committee

Any phase of this Twenty Committee activity may be discussed from the floor. This is entirely an informal meeting. Committee Chairman will be present for participation.

Session 5—Tuesday AM—May 17

Purification Division - Water Standards

Introduction ..... Ray L. Derby
New U. S. Public Health Service Drinking Water Standards ..... O. C. Hopkins, Oscar Gullans
Quality Water Standard ..... Elwood L. Bean
Operator's Viewpoint ..... John R. Baylis
Legal Viewpoint ..... Frank E. Maloney
Open Discussion

Session 6—Tuesday PM—May 17

Management Division - Commercial

Machine Billing Procedures—
Panel Discussion .....R. D. Tompkins, John G. Copley
Administrative Manuals .....William D. Hurst
Election of Officers
Present Philosophies of Rate Making .....Samuel S. Baxter

Session 7—Tuesday PM—May 17

Distribution Division - Water Mains

Water Main Breaks—
Panel Discussion .....Gerald E. Arnold (Mod.)
Edward J. Clark,
Gerald Remus
Howard W. Niemeyer
Extension Policies .....Henry J. Graeser
Loss of Pipe Line Carrying Capacity .....Thurston E. Larson

Session 8—Tuesday PM—May 17

Water Resources Division - Water Storage

Joint Sealing in Concrete Paved Reservoirs ....H. Ward Taylor
Underground Waste Disposal—
Task Group Report .....Lynn M. Miller
Ground Water Recharge—Task Group Report ....John J. Baffa
Operation Experiences Under New Water
Laws .....Harry E. Jordan
Air Inflated Dams .....N. M. Imbertson

Session 9—Wednesday AM—May 18

General Session

U. S. Water Resources .....Theodore M. Schad
Protection of Water Resources .....Mark D. Hollis
Water Resources in Florida .....John W. Wakefield
New Constitution and By-Laws .....Lauren W. Grayson

Session 10—Wednesday PM—May 18

Open Session
Water Works Practice Committee

Revision of Positive Displacement
Meter Standard .....James G. Carns, Jr.
Review of Various Types of Concrete
Pressure Pipe in Use .....Ernest W. Whitlock
Progress in Certification .....Lewis S. Finch
Teel Tank Painting—Including Resins .....J. O. Jackson
High Tensile Steel .....L. R. Howson

Session 11—Wednesday PM—May 18

Purification Division - Coagulation and Reports

Coagulation .....A. P. Black
Discussion .....Rolf Eliassen
Recovery and Reuse of Alum Sludge .....J. M. Roberts
Election of Officers
Comparison of Various State Water Works
Criteria .....William W. Aultman
Committee Reports

Session 12—Thursday AM—May 19

Water Resources Division - Surface Supplies

A New Look in Streamflow Data .....Joseph VanBrunt Wells
The Everglades—Past, Present and Future ...Col. Paul Troxler
Taste and Odor Problems in New Reservoirs
Located in Wooded Areas .....E. Jerry Allen
Election of Officers
Progress in Water Desalting .....Allen Cywin, L. S. Finch
Water For Tomorrow .....Gordon E. McCallum,
Robert W. Haywood, Jr.

Session 13—Thursday AM—May 19

Distribution Division - Pipe, Coatings and Construction

Report on Cooper Water Service Study .....Kenneth E. Shull
Election of Officers
Plastics & Plastic Pipe .....R. J. Sweitzer
Some Solutions to Unusual Pipeline
Construction Problems .....H. Arthur Price,
Harold L. Gunther,
Dean C. Noll
Epoxy Resins For Coating Pipes and Tanks ...Loring E. Tabor

Session 14—Thursday AM—May 19

Advancement-Management Division - Financing Water Utilities

The Advancement Program
Accomplishments .....Fred Merryfield
How Bond Issues Were Passed:
Fergus Falls, Minnesota .....Howard J. Sowden
Denver, Colorado .....Robert S. Millar
Community Relations is a Day to Day Job ..Thomas V. O'Leary

Session 15—Thursday PM—May 19

Joint Session
Distribution & Management Divisions

Water Demands—Progress Report .....H. E. Hudson, Jr.
Submersible Water Well Pumps .....Claud R. Erickson
Work Measurements and Standards .....C. Adleman
Duties and Responsibilities of the
Utility Manager .....William R. Seeger

Session 16—Thursday PM—May 19

Purification Division - Pollutants in Water

Estimating Human Radiation Exposure on the
Animas River .....E. C. Tsivoglou,
S. D. Shearer,
J. D. Jones,
D. A. Clark
Pollutions in Water—Panel Discussion
Effects of Fertilizers, Agriculture & Aquatic
Chemicals .....Clarence M. Tarzwell
Effects of Salinity Caused by Irrigation .....L. V. Wilcox
Effects of Sewage & Industrial Wastes ....Ralph E. Fuhrman
Effects of Syndets .....Graham Walton
Effects on Taste and Odors .....H. O. Hartung
Open Discussion

Connecticut To Test Using Reservoirs for Recreational Activities

The formation of a special commission to regulate the use of the recently completed Hogback Dam Reservoir for public recreation was announced by the Connecticut State Board of Fisheries and Game.

Director Lyle M. Thorpe said the work of the new commission will be a pilot attempt of the state to use drinking water reservoirs for recreational use. He said there have been repeated objections to such multiple use of the reservoirs although it is a practice is some other states.

The creation of the commission was authorized by the 1949 state legislature in a public act approving construction of the Dam. The legislation authorized a seven-member commission which would include the representatives of the four towns affected by the Dam, and three agencies: the Metropolitan District Commission, the State Health Department and the State Board of Fisheries and Game.

The recreational use of the Dam was offered as a compromise by the Metropolitan District Commission after previous attempts to obtain authorization for construction of the dam were unsuccessful.

REPORT FROM ABROAD

London County, Beacon Plant treats 178 mgd after . . .

Sewage Works Expansion *costing over $27 million*

by WILLIAM A. HEATH
London, England

EDITOR'S NOTE: A century old British sewage treatment plant has been remodeled and enlarged to provide complete treatment to an average daily dry weather sewage flow of 178 mgd. The plant serves an area of 112 sq. miles having nearly 2,500 miles of sewers.

Primary treatment includes screening, grit removal, preaeration and settling. Primary and secondary sludge digestion includes facilities for prethickening raw sludge, sludge gas storage and a fleet of ships to dispose of digested sludge at sea. Secondary treatment is by activated sludge.

The author describes a tremendous physical plant with a capability for even additional expansion.

■ EXTENSIONS costing over 27 million dollars have recently been completed to the London County Council's Northern Outfall Works at Beckton, on the eastern outskirts of London, England.

History of the works goes back nearly a century. In 1864 three outfall sewers and four large storage reservoirs capable of holding six hours' dry weather flow were completed. Covered sedimentation channels with a capacity of 13 mil. gal. sludge settling tanks, pumping plant, and elevated sludge storage tanks were constructed in 1889 and a fleet of six ships was commissioned to dispose of sludge at sea.

In 1931 a surface aeration plant to treat 10 mil. gal. of sewage a day was brought into operation; later enlargements enabled capacity to expand to 60 mgd. The second world war interrupted further development and it was not until 1951, when government restrictions on capital expenditure were relaxed, that expansion was resumed. The latest extensions, now completed, include an activated sludge plant to give biological treatment to an additional 60 mil. gal. of sewage a day, a sludge digestion plant to digest all the sludge produced, and a power house for generating electricity and providing compressed air. Although the present programme of extensions at the works is now complete, provision has been made in the lay-out for future additional plant if it should prove necessary.

The area draining to the works comprises the whole of the administrative county of London north of the River Thames together with the out-county areas of East Ham, West Ham, Ilford, Barking, Leyton, Walthamstow, Hornsey, Tottenham, Wood Green, Willesden and Acton. This area totals 112 square miles and has a population of nearly three millions.

There are 237 miles of main sewers in the area; 1,220 miles of local sewers; over 1,00 miles of sewers in the out-county areas; and six pumping stations with an aggregate pumping capacity of 69 mil. gal./hr.

Five 9 ft. by 9 ft. horseshoe-shaped brick sewers built in an embankment convey the sewage and storm water to the works. No pumping is required as the sewage flows by gravity through the plant and the treated effluent discharges to the River Thames at Barking Creek. The dry weather flow at the works is 178 mgd.

The works is sited on marshland and the strata consist of peat and poor quality clay overlying ballast which varies considerably in thickness.

Primary Treatment

Six detritus pits each 130 ft. long are provided to deal with flows up to a rate of 750 mgd. Flow to each pit is controlled by hydraulically operated penstocks to a velocity of between 0.8 and 1.2 ft/sec. Between these velocities the sand and grit settles in the pits. The grit in the pits is removed by dragline scrapers which deposit it on a moving belt for conveyance to a storage hopper. It is finally disposed of as fill on adjacent low-lying land.

Remote control panels for operating the penstocks are installed in the control house together with hydraulic pumping sets and a stand-by generator for use in case of a failure in the main supply of electricity. The amount of grit removed in a year is approximately 10,000 tons.

All sewage flowing to the new primary sedimentation tanks passes through course and medium screens. The screens are brought into operation according to the rate of flow. Six sets of coarse and medium screens are provided.

The screenings collected on the medium screens are mechanically raked and passed through disintegrators. The disintegrated screenings are returned to the sewage upstream of the screens.

A control room is provided in the screen house where all penstocks in the vicinity of this house can be operated by remote control. This room also contains the venturi meter flow indicators and charts registering the flow through the sedimentation tanks.

After screening, the sewage is given pre-aeration treatment in the twin supply channels leading to the sedimentation tanks. The air, normally 3,000 cfm, is supplied by electrically-driven "Roots" type blowers. The retention time in the channels average 20 minutes.

The sixteen sedimentation tanks, each 250 ft. long between inlet and outlet weirs, 75 ft. wide and 11 ft. deep, have a total capacity of 20 mil. gal. and are designed to treat a maximum rate of flow of 300 mgd.

These tanks remove approximately

DETRITUS PITS, general view showing scrape loader, conveyor belt and hopper.

70 per cent of the suspended solids in the sewage. The effluent passes over outlet weirs to an open channel connected to the activated sludge plants for secondary treatment.

The sludge which settles on the floor of the tanks is swept by electrically driven Mieder type scrapers to troughs at the inlet end of the tanks where transverse "flight collectors" sweep the sludge to a hopper between each pair of tanks. Sludge is removed from the tanks by telescopic weirs and flows by gravity to sumps at the sludge pumping station where it is pumped to the sludge digestion plant.

Four sludge pumps, each capable of pumping 600 tons an hour; and two drainage pumps, each with a capacity of 1,000 tons an hour; are provided in the sludge pump house. The sludge pumps come into operation automatically when the sludge in the sumps reaches a predetermined level.

Secondary treatment

Activated sludge plant No. 1, a partial treatment plant, is a surface aeration plant with separate reaeration by diffused air.

In this plant the activated sludge is reaerated by air blowing for approximately 60 hours in reaeration channels, somewhat similar in design to normal "ridge and furrow" aeration sets, before being returned to the aeration sets. In the six aeration sets the activated sludge and settled sewage are mixed and circulated by means of paddles in double compartment channels with intercommunicating ducts before passing to the final settling tanks. The respective capacities of the reaeration channels and aeration sets are 7.2 and 7.0 mil. gal.

Activated sludge plant No. 2 is a diffused air plant which treats 60 mil. gal. of settled sewage a day. There are six aeration sets, fifteen final settling tanks, a control house and a pumping station.

The aeration sets have a total capacity of 22.8 mil. gal. giving 9 hours' retention time for a flow to 60 mgd.

Each aeration set has eight channels, 390 ft. long, 16 ft. wide and 14 ft. deep, fitted with about 15,000 seven inch dia. diffusers for blowing air into the mixture of sewage and activated sludge.

The total quantity of air supplied to the diffused air plant, including that used in supply channels and air lifts, is 70,000 cfm of free air at 6.5 to 7.5 psi pressure.

The mixture of settled sewage and activated sludge flows through the eight channels of each set before passing to the final settling tanks

ACTIVATED SLUDGE plant no. 1 and reaeration channels (left). Operating gallery for no. 2 plant (right) is over 1,000 ft long.

where the activated sludge is settled out and returned to the aeration sets.

The final settling tanks are 110 ft. in diameter and the depth of the flow below the circular double outlet weir is 12 ft. at the periphery and 14 ft. at the centre. The activated sludge settles to the floors of the tanks and is swept to central hoppers by "tow-arm" Dorr scrapers. Sludge is then returned to the aeration sets through pipe lines, air lifts and open channels. The air lifts are designed to lift to a maximum of 30 mgd of sludge to the aeration sets for mixing with the settled sewage.

The final effluent discharges over the outlet weirs to the main effluent channel leading to the River Thames.

The main controls and meters for the operation of the plant are concentrated in an operating gallery over 1,000 ft. long by 46 ft. wide. Incorporated in the gallery is the pumping station housing drainage pumps and surplus sludge pumps.

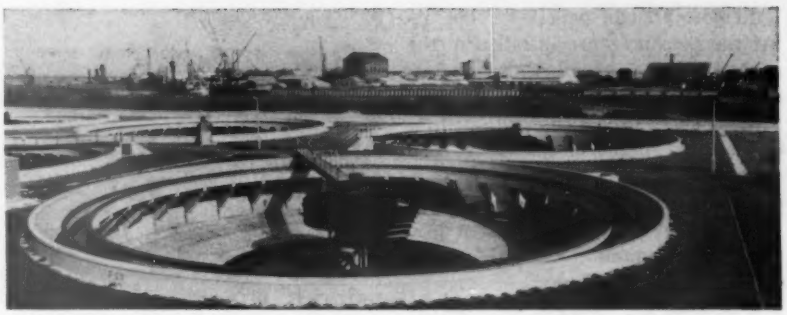
Sludge treatment

The sludge (including surplus activated sludge) from the primary sedimentation tanks and the sedimentation channels is pumped to four dewatering tanks with a total capacity of 19,000 tons. These tanks are each fitted with "picket fence" thickener mechanisms and are normally worked as two pairs.

The full sequence of filling and thickening, decanting and emptying occupies 48 hours and is automatically controlled by a time clock and relay panel in the control room.

The thickened sludge from the dewatering tanks is pumped simultaneously to 16 primary digestion tanks via a system of pipes arranged to give uniform distribution. Before entering these tanks, the sludge passes through heat exchangers of the "Rosenblad" type where heat is recovered from the outgoing sludge and transferred to the ingoing sludge. The amount of heat transferred is in the order of 7.5 mil. BTU/hr when the outgoing sludge is reduced in temperature by 15 deg. F.

There are 16 primary digestion tanks each 80 ft. diameter by approximately 32 ft. side water depth, with a total capacity of 76,000 tons. The temperature of the sludge in the tanks is maintained at 85 deg. F. by means of two external heaters. The external heaters are supplied with water heated by waste heat recovered from the exhaust gases from the gas turbines in the power house.



FINAL SETTLING tanks are 110 ft. in diameter.

Each tank has a spiral-guided floating gas-holder having a total capacity of approximately 28,000 cu. ft. This represents 6.5 hours' storage of the normal full day's production of 2.5 mil. cu. ft. of sludge gas. The gas has a normal composition by volume of 70 per cent methane and 30 per cent carbon dioxide, and a net calorific value of approximately 625 BTU cu ft.

After approximately 10 days' digestion in the primary tanks the sludge gravitates to four open secondary tanks for a further period of digestion to assist in the dewatering of the sludge and so reduce the volume for disposal at sea. The storage reservoirs constructed in 1864 have been converted for use as secondary digestion tanks and have a total capacity of 192,000 tons.

Provision is made for decanting liquor at various depths and the liquor is pumped back to the incoming sewers. In the pump houses adjacent to the secondary tanks four pumps each of 2,400 tons an hour capacity and two pumps of 200 tons an hour capacity are provided for pumping digested sludge to overhead storage tanks or direct to the sludge vessels.

Four twin-screw oil-fired sludge ships, each of approximately 1,500 tons capacity, are in service for disposal of the sludge at the Black Deep, off the mouth of the River Thames, some 55 miles from the works.

Power house

The power house, 280 ft. long by 105 ft. wide, is constructed in reinforced concrete with a shell room of pre-cast sections, post-tensioned *in situ*. It houses five gas turbine blowers, three gas turbine alternators, air filtration plant, gas compressors, heat exchangers and other ancillary Plant.

Both the blowers and the alternators are driven by similar turbines of 960 BHP. These are of the open cycle two-shaft design developing the required horse power at moderate blade temperature.

The brake thermal efficiency of the turbines is 21.2 per cent and the waste heat recovery improves the overall efficiency of the installation to approximately 50 per cent. Sludge gas is normally used as a fuel, but diesel oil or fuel oil can be used as an alternative fuel.

The air blowers are of the centrifugal single stage double inlet type and each supplies 25,000 cfm of air at 7.5 psi pressure.

The alternators generate 620 kw at 3,300 volts and 0.8 power factor running at 1,500 rpm.

Sludge gas is delivered at a pressure of 4 inches water gauge and is compressed to 120 psi by means of five electrically-driven compressors which are automatically brought into service as required.

The eight water heaters associated with the gas turbines each extract 3,100,000 BTU/hr from the exhaust gases and heat water for sludge heating from 125 deg. F. to 165 deg. F.

Six electrostatic precipitators, each filtering 45,000 cfm, are installed to ensure a very clean air supply for the diffusers and the gas turbines.

All necessary instruments are fitted to provide complete information on plant operating conditions. The principal instruments and controls are grouped in the control room, including a main electrical control panel for the remote operation and control of the 3,300 and 415 volt switch-

gear, alternators, and gas compressor motors. The control panel is complete with a mimic diagram which gives immediate indication of the switching arrangements and plant in service.

Ancillary buildings

Ancillary buildings include an administration block, laboratories, a workshop and stores and staff accommodation for day workers.

Systematic examination is made in the general laboratory of samples of sewage, effluents and sludge from all important points and at all stages of treatment. It is essential that the samples analysed should be representative and for this reason hourly samples are taken by automatic apparatus at several positions in the plant.

There is also a research laboratory where staff are engaged on the investigation of works problems as well as on the wider issues connected with sewage and trade effluent treatment.

The laboratories have a comprehensive range of equipment including electronic apparatus with specially constructed counter heads which are used in conjunction with radiochemical tracers to study the movement of sewage and effluents in the treatment plant.

In the old engine house two diesel driven and one electricically driven sludge pumping sets and two electrically driven liquor pumps together with the hydraulic pumping sets are in use in connection with the operation of the old sedimentation channels.

The general scheme of electrical distribution at the works consist of a 3,300 volt ring main passing through five sub-stations and the power house. Each sub-station contains high voltage switchgear to control the ring main and one or more 500 kva 3,300-/415 volt transformers, and low tension distribution switchgear.

Mammoth Pool Project Nears Completion

The first generating unit of Southern California Edison Company's $50,000,000 Mammoth Pool project was put into operation recently, virtually completing one of the West's latest great hydroelectric projects. Mammoth Pool's second unit is expected to be put into service later this month.

The project is the newest addition to Edison's intensive development of its Big Creek-San Joaquin River hydroelectric system in the High Sierra, approximately 60 miles northeast of Fresno.

This multi-purpose power project, conceived in the 1890's, has been developed during the past 49 years with a total investment of approximately $212,000,000. Fourteen dams, six major lakes and eight powerhouses have been created in this wilderness. They control the waters of the San Joaquin River and its tributaries for use not only in the generation of electricity but also for recreation, flood control and storage of irrigation water.

The water which turns the turbines comes to the powerhouse through an eight-mile tunnel, which was cut through solid rock from the Mammoth Pool lake upstream.

To create the lake, Edison had one of the world's highest rolled earth fill dams constructed (450 feet from bedrock). Behind the 30-story-high dam, a new lake with a capacity of approximately 123,000 acre feet is now filling, and will be available for recreational use this summer.

Because of the intensive development and control of San Joaquin River by the investor-owned utility's Big Creek-San Joaquin River project, it has been described as a model of efficient development of a natural resource. The river's waters are known to engineers as the "hardest working water in the world," because the water is used over and over to generate electricity in powerhouses at successively lower altitudes.

For construction of the Mammoth Pool project, fifteen miles of new roads and bridges were built. Many of these will be turned over to the U. S. Forestry Service for recreation use by the public and for fire fighting.

Artificial Recharge of Ground Water

Experimental "artificial recharge" of water-bearing rocks a few miles east of Walla Walla, Wash., has shown the practicability of using this means of back-stopping the municipal water supply.

The experiment was made as part of a long-term cooperative program of the Department of the Interior's, Geological Survey and the Washington State Department of Convervation to evaluate the State's groundwater resources and devise conservation techniques.

About 70-acre feet of the creek water was injected, at an average rate of 650 gallons per minute, into an 1,169-foot municipal well penetrating the water-bearing rock formation known to geologists as the Columbia River basalt. The study area is one in which the structure of the rocks limits natural recharge, and there has been concern over the persistent lowering of water level caused by years of pumping.

The chemical and bacteriological quality of the injected water was excellent, and it contained only 2 parts per million of suspended sediment. Although the quantity of water injected was small, the experiment was successful in showing that artificial recharge of basalt on a continuing basis is feasible.

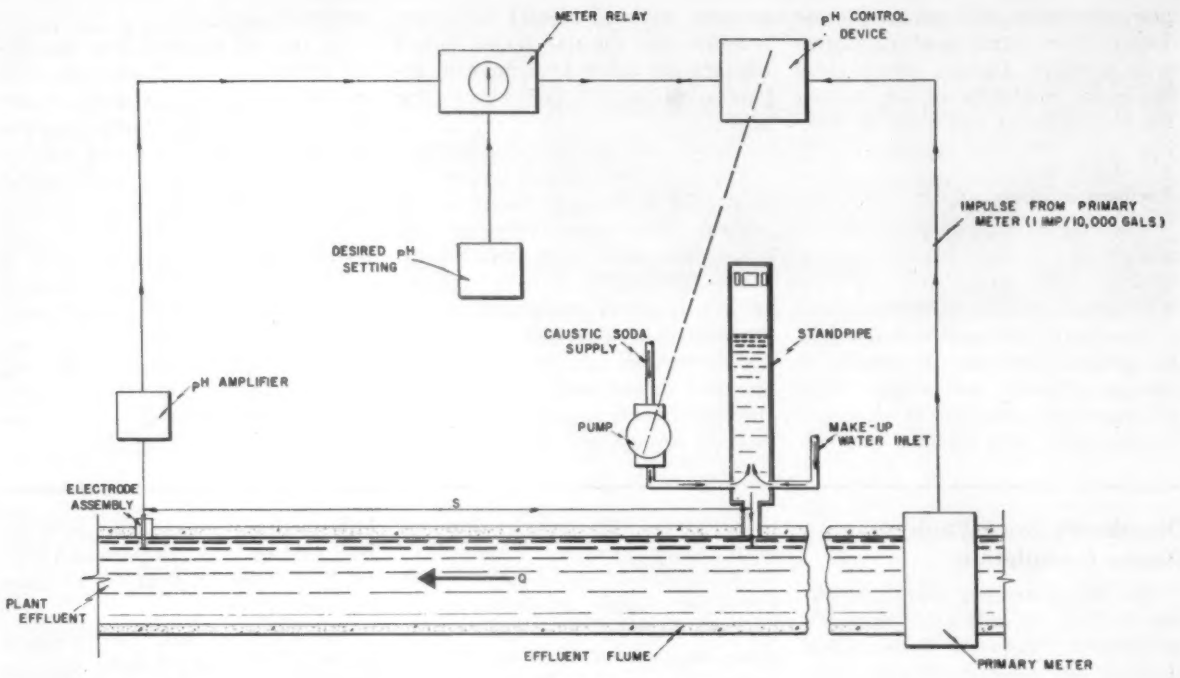
Some reduction in well yield occurred as a result of the recharging experiment. However, it is believed that the loss does not represent permanent deterioration of the well. With a carefully controlled schedule of alternating recharge and pumping, it is believed that as much as 1,000 gpm can be injected into the well during the nine months of the year when the creek water is available.

North Carolina Acts For Clean Streams

By adopting classifications for water quality of the Neuse River Basin, the North Carolina State Stream Sanitation Committee set standards to be met by Municipal and industrial water users, effective April 1.

The committee followed staff recommendations by making a number of changes in original classification proposals. Its action was based on requests made during public hearings last June in Goldsboro and New Bern.

With the adoption of water standards, the committee now can take legal steps, if necessary, to clean up areas of pollution in the Neuse.



Flow diagram showing components of a device for . . .

Automatic ph Control *of finished waters*

by W. BRUCE MURRAY, Civil Engr. Assoc.,
Water Dept., Long Beach, Calif.

EDITOR'S NOTE: The device described is a "do it yourself" approach for maintaining a desired pH value within plus or minus 0.05 units in treated water. The operation of the device is explained and each component part is identified so that anyone with a limited knowledge of electronics can build such a device himself.

■ MUNICIPAL TREATMENT PLANTS are generally required to practice some form of pH correction on their finished water as a means of correcting any corrosive tendencies the water may have acquired during treatment. Changes in prechlorination or coagulation dosages or even variations in the raw water itself provide operating personnel a problem in maintaining a continuously uniform pH. The device described here is an inexpensive controller which can be assembled by anyone with a moderate knowledge of electronics. Although basically simple, the accuracy of the device is such that it will hold the desired pH on the finished water to ±0.05 units.

How the device operates

To illustrate the method in which the pH control device functions, suppose as a typical example it is desired to maintain a uniform pH in the effluent of a treatment plant in which the pH value is normally quite irregular. Consider the plant effluent at a variable flow **Q** to be metered by a primary meter which provides an electrical impulse each time it passes 10,000 gallons of water. Located downstream at a certain distance **S** from the point of chemical injection (caustic soda in this example) is a pH detecting electrode assembly which is continuously sampling the effluent and furnishing a dc output to a meter relay proportional to the instaneous pH of the effluent. Opposing this electrical signal is the output from a bridge circuit which establishes an electrical value equivalent to the desired pH. At electrical zero (the point of bridge balance) the pH of the effluent is equal to the desired pH

and there is no change in the rate of caustic adjustment. If there is a gain or loss in the pH of the effluent the indicating needle on the meter relay will deviate from its centered position and close with an appropriate set of relay contacts and eventually cause an increase or decrease in the rate of feed. The caustic soda pump in this illustration is operated on a time-impulse basis in which the pump will function just long enough to provide the quantity of caustic necessary to dose the 10,000 gallon increment of effluent water (as indicated by the primary meter) to the desired pH. The meter relay is indirectly responsible for either shortening or lengthening the period of pump operation by varying the time constant of the pH control device every time an impulse is received from the primary meter. If the pH of the plant effluent is equal to the desired pH, the pump time constant remains unchanged since the meter relay is at balance and the caustic pump will continue to operate at the same previous time interval upon its next receipt of a 10,000 gallon impulse. Thus the automatic pH controller has two important features: proportional control (the frequency of pump operation is directly proportional to the number of impulses received or the rate of flow) and floating control (the amount of caustic entering the plant effluent per cycle is injected at a compensating rate as long as the pH deviates from the desired value).

To summarize, the following sequence of events takes place in the automatic control of pH:

1. The primary meter initiates a cycle by providing an electric pulse to the pH control device.

2. The caustic pump operates for a period of time as determined by the pH control device and attempts to supply just enough caustic to adjust the plant effluent to the proper pH.

3. The pH electrode assembly located downstream from the point of caustic injection provides an output signal proportional to instantaneous pH of the plant effluent.

a. If this output is higher than that furnished by the desired pH setting, the time constant in the pH control device is decreased thus shortening the "on time" of the caustic pump for the next cycle.

b. If this output is lower than that furnished by the desired pH setting, the time constant in the pH control device is increased thus lengthening the "on time" of the caustic pump for the next cycle.

c. If this output is exactly the same as the desired pH setting, the time constant in the pH control device is left unchanged and the caustic pump "on time" is also left unchanged for the next cycle.

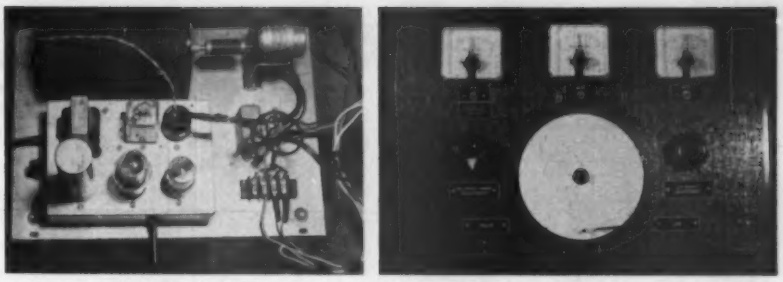


FIG. 1. CONTROL CENTER for the device. Top view (left) shows reversible motor driven potentiometer; Front view (right) of control panel illustrates recording feature of controller.

Circuit Description

The automatic pH control device illustrated in Figure 3 is essentially an electro-mechanical switch the contact time of which is dependent upon the variable potentiometer $\mathbf{R_9}$ and the three capacitors $\mathbf{C_5}$, $\mathbf{C_6}$ and $\mathbf{C_7}$. The SPDT relay $\mathbf{RLY_1}$ in the plate circuit of $\mathbf{V_2}$ controls the "on and off" time of the caustic pump through the time limiting RC network on the parallel grids of $\mathbf{V_2}$. During normal operation, upon receipt of a 10,000 gallon impulse signal from the primary meter, the SPDT relay $\mathbf{RLY_2}$ will initiate a time cycle on the grids of $\mathbf{V_2}$ which will activate the caustic pump relay $\mathbf{RLY_1}$ for a period of time sufficient to treat the 10,000 gallon volume of water. With zero voltage across the RC network, maximum plate current flows through the coil of $\mathbf{RLY_1}$ which closes the relay and disconnects the caustic pump from the circuit. The instantaneous closure of the contacts on $\mathbf{RLY_2}$ throws a negative voltage across the RC network ($\mathbf{R_9}$, $\mathbf{R_{10}}$, $\mathbf{C_5}$, $\mathbf{C_6}$ and $\mathbf{C_7}$) which charges this combination to a maximum value and causes the plate current of $\mathbf{V_2}$ to fall to zero since the tube is at cut-off. The relay $\mathbf{RLY_1}$ is deenergized in this condition and the caustic pump begins operation. The period of time the tube $\mathbf{V_2}$ remains at cut-off is dependent upon the rate of current discharged through the fixed resistance $\mathbf{R_{10}}$ and the variable resistance $\mathbf{R_9}$. The circuit time constant with the components shown is

$$T = 2.86 \text{ RC} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where,

T = time in seconds
C = capacity in microfarads, and
R = resistance in megohms

With the fixed capacity of eight microfarads ($C_5 + C_6 + C_7$) and the fixed resistance $\mathbf{R_{10}}$ of 220,000 ohm,

$$T = 22.88 \text{ } R_T \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where,

$R_T = R_9 + 0.22$ (megohms)

The variable resistance potentiometer $\mathbf{R_9}$ which provides 2.5 megohms of resistance in 40 turns is singularly the most important item in the circuit, since with its unusual resolution time constants of a fraction of a second can be obtained within a few degrees of shaft rotation. The double contact meter relay M. R. controls the resistance value of the potentiometer $\mathbf{R_9}$ by means of the reversible motor which is connected directly to its shaft. These contacts which are a part of the meter relay are located equidistant from electrical zero with the needle contact mechanism floating in the "dead zone" between either contact. If no error signal appears be-

FIG. 2. pH ELECTRODE assembly is mounted on plant effluent flume.

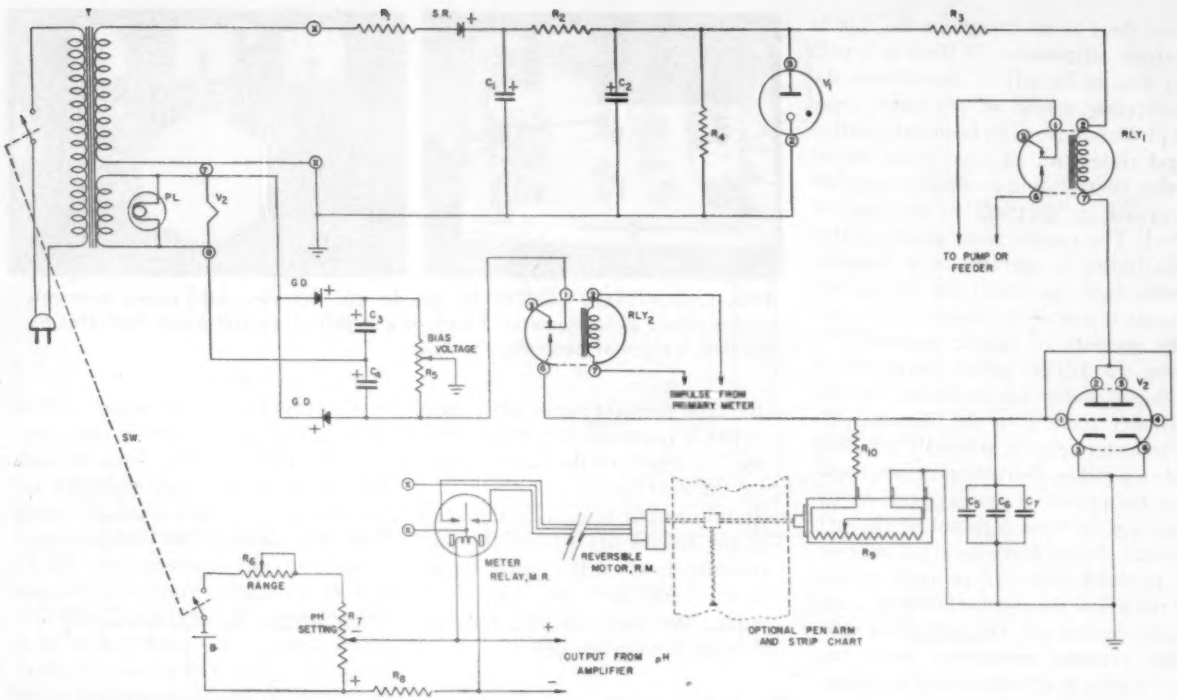


Fig. 3. Automatic pH Controller Assemblies

Transformer: T-125 volt @ ma power transformer with 6.3 v. filament (Stancor PS 8415)

Rectifiers: S. D.— silicon diode, 150 ma; G. D.— germanium diode, IN34A

Resistors: R_1—22 ohms, 1 watt, R_2—3300 ohms, 1 watt; R_3—4700 ohms, 1 watt; R_4—51,000 ohms, 1 watt; R_6—2,200 ohms, ½ watt; R_{10}—220,000 ohms, ½ watt; R_5—1000 ohm wirewound pot; R_9—5000 ohm wirewound pot; R_7—1000 ohm wirewound pot; R_8—2.5 megohm, 40 turn potentiometer, Series E (Helipot, Beckman Instruments, Inc.)

Capacitors: C_1, C_2—250 mfd 150 volt electrolytic; C_3, C_4—50 mfd 50 volt electrolytic; C_5, C_6, C_7—2 mfd metallized paper

Tubes: V_1—OC3, 105 volt voltage regulator; V_2—6SN7GTA

Relays: RLY_1—SPDT plate circuit relay 10,000 ohm coil (Potter & Brumfield KCP5; RLY_2—SPDT 115 volt 60 cycle relay, 2200 ohm coil (Potter & Brumfield KRP11A)

Meter Relay: M. R.—Double contact, zero center 10-0-10 microamps dc, Versatrol (Assembly Products, Inc., Chesterland, Ohio)

pH Amplifier: Model W industrial pH meter (Beckman Instruments, Inc.) or Model 115 Photovolt electronic pH meter (Photovolt Corporation)

Electrode Assembly: Flow through type, calomel and glass electrodes (Beckman Instruments, Inc.)

Reversible Motor: R. M.—2 RPM, 115 volt 60 cycle synchronous motor, Series 430 (Bristol Company)

Battery: B—1.5 volt, size D

Switch: SW—DPDT toggle

Misc: 8 x 10 inch aluminum chassis; P. L.—pilot light, 6.3 volt, octal sockets; one 40 revolution spiral geared shaft (¼ inch) with follower set screw and pen arm mechanism for optional recorder.

tween the bridge output consisting of the desired pH setting R_7, the range adjustment R_6, the fixed resistance R_8 and the output from the pH amplifier, the needle contact remains in a position of balance and the motor driving potentiometer R_9 is inoperative. If an error signal does appear across the meter relay, the unbalance closes the needle mechanism with the appropriate contact and depending on the pH variation of the effluent, either increases or decreases the value of R_9 with the direction of motor rotation. If it is desired to incorporate a recording mechanism into the controller it may be done by inserting a 40 turn spiralled shaft between the motor and the potentiometer together with a pen arm mechanism and some form of strip or circular chart as is illustrated in the drawing.

The self-contained power supply is half-wave rectified and heavily filtered to reduce ripple. Regulation is necessary in order to obtain a uniform operating point for relay RLY_1 operation. The bias voltage supply is a voltage doubler which receives its ac input from the 6.3 volt filament taps on the power transformer **T**. This bias voltage adjustment is variable from 0 to 13 volts by means of the bias voltage control R_5. Note that the ac supply on the filament is left floating since the positive side of the dc output is grounded. With a fixed bias voltage of −9 volts dc applied to the RC network and to the grids of V_2, the time constant for the system (length of pump operation per 10,000 gallon cycle) varies from 3.7 to 27.5 seconds with R_9 changing from zero to 40 turns. Other time constants can be obtained by either increasing or decreasing the bias voltage supply or by adding or subtracting capacitance in the RC network.

Plant application

Two physical problems which concern themselves with the automatic pH control device is the method of uniformly dispensing the caustic soda solution to the plant effluent during a 10,000 gallon cycle and the distance the electrode assembly is placed downstream from the point of chemical injection.

If **Q** is the flow of water in mgd

and **T** the time in seconds to pass 10,000 gallons of water, it can be shown that:

$$T = \frac{864}{Q} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Equation 3 is a converging series since the larger values of **Q** produce smaller increments of **T**. Thus a pump operating at a fixed calibration point might possibly have a considerably longer "off" period at a minimum flow of the plant effluent than at a maximum flow which would amount to the caustic being added in slugs. This condition is very undesirable and is one of the most troublesome features of the time-impulse method of chemical treatment. With systems which flow by gravity a possible solution is to inject the caustic soda into at least a 4 inch standpipe or surge chamber (open to atmosphere) in which a continuous flow of water ± 35 gpm is being added. The caustic and make-up water in the chamber provide a slight additional head above the normal hydraulic gradient at that point which results in a uniform gradual dispensing of the caustic to the effluent.

The distance **S** downstream from the point of chemical injection to the point of pH detection in which a good mix might be expected is directly related to the size of the plant effluent conduit and the maximum flow **Q** which might be encountered. As a general rule, **S** for a good mix should be at least 50 feet with a 4 x 4 ft rectangular conduit (16 sq. ft.) and a maximum **Q** of 26 mgd.

Summary and Conclusions

The automatic pH controller described operates on the basis of proportional plus floating control which provides the following features:

1. Accuracy—pH control within ±0.05 pH units from the desired value.
2. Fast recovery.
3. Low cost.
4. Simplicity—the device can be constructed by semi-skilled personnel.
5. Ease of operation—one manual adjustment.
6. Dependable operation—long component life.
7. Recording—pH variations can be recorded on a strip or circular chart for a permanent record.

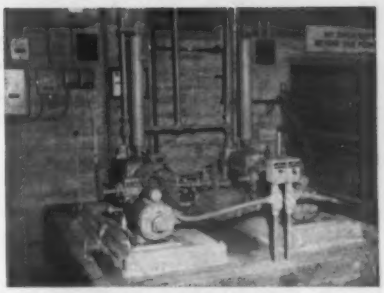


FIG. 4. CAUSTIC PUMPS are driven on time-impulse basis.

FIG. 5. STANDPIPE (center) is point of caustic injection.

Bundesen Receives Citation For Sanitation Achievements

A presentation of a Resolution was made to Dr. Herman N. Bundesen, President of the Chicago Board of Health, on March 1, 1960, by Mr. Luke J. Keefe, President of the Plumbing Contractors Association of Chicago and Mr. Ludwig H. Koepke, Immediate Past President of the Illinois Association of Plumbing Contractors.

The Resolution is a salute to Dr. Bundesen for his outstanding services to the health field; for the contributions made by him to the Art and Science of Sanitation and Plumbing; and as an observance of Dr. Bundesen's Silver Anniversary as an Honorary Member of the National Association of Plumbing Contractors. He is the first person to be so honored.

The honor was conferred on Dr. Bundesen, Health Commissioner, in 1935, following his intensive investigations and study, during Chicago's World Fair of 1933, that ferreted out cases of amebic dysentery resulting from contamination in plumbing with faulty cross connections in a Chicago hotel. Even hazards of minor importance were corrected or eliminated. He was instrumental in focusing national attention upon the relationship between good plumbing, sanitation, and good health, by pointing out the fact that water and waste piping in hotels, hospitals, office or industrial buildings, in some instances housing thousands of people, is comparable in importance to a water works or a sewer system of an entire city.

The cooperation of the local plumbing industry made possible the establishment of a Chicago Plumbing Testing Laboratory for the evaluation of plumbing procedures, and in obtaining basic engineering data necessary for the proper design of fixtures, valves, vacuum breakers, and other devices. The Board of Health worked for the establishment and operation of this laboratory in cooperation with the Plumbing Contractors Association of Chicago, the Journeymen Plumbers Union Local #130 and the Chicago Department of Public Works.

It was during 1935, that the National Association of Plumbing Contractors was successful in having a joint resolution passed by the U. S. Congress which provided for investigation of plumbing sanitation in all federal buildings throughout the country.

Revenue Increase Reported by Puerto Rico Authority

The revenues of the Puerto Rico Aqueduct and Sewer Authority for the first six months of the fiscal year (ending December 31, 1959), totaled $4,788,711, compared with $4,337,597 for the corresponding six months of the preceding fiscal year. This represents an increase of 10.4 per cent, according to Rafael V. Urrutia, Executive Director of the Authority.

Engineering Firms Merge

W. R. Holway and Associates and Cornett, Wood and Associates have announced the formation of a new organization known as, Holway Engineers, Inc., Consulting Engineers. The firm is engaged in the practice of sanitary, structural, hydraulic, electrical and mechanical engineering, and has its offices in Tulsa, Oklahoma.

Its first major contract was awarded by the Henryetta, Okla., city council to report on the city's over-all water needs; the city plans to vote bonds to correct shortages in its water treatment and distribution system.

Anaerobic-Aerobic Pond Study Begins

■ The Industrial Research Division's sanitary engineering research section has received a $16,100, U. S. Public Health Service grant for limnological study of anaerobic-aerobic sewage ponds.

Prof. G. H. Dunstan, head of the sanitary engineering laboratory, and principal investigator under the grant, reported the money had been made available from the budget of the Department of Health, Education and Welfare and covers the first year of a proposed three year study. Additional funds, totalling approximately $15,000 each year for the subsequent two years of the study, have been approved subject to availability.

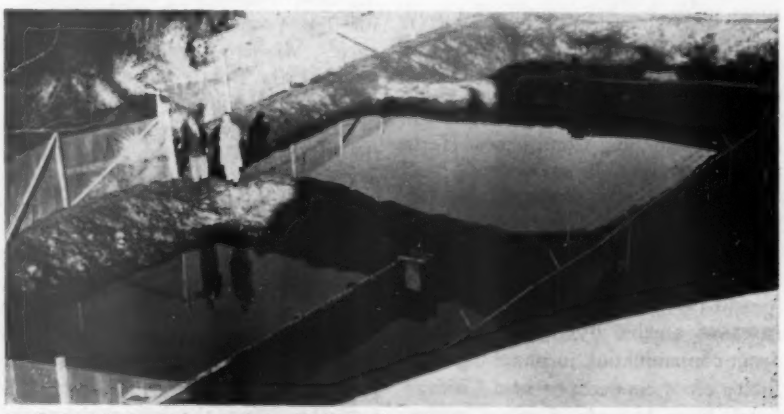
Prof. Dunstan pointed out that research under the public health service grant will serve as a continuation of an investigation of stabilization pond loadings being conducted by Dr. Rolf T. Skrinde, assistant sanitary engineer and co-investigator for the project. Skrinde's work is being financed by a one-year grant from Washington State University's Medical-Biological research fund. This investigation entailed construction of three small experimental ponds at the Pullman sewage treatment plant during this past summer. These ponds were put into operation December 1, and will be used on both projects which will be merged this coming June. With the exception of some preliminary groundwork, the study under the U.S.P.H.S. grant is scheduled to begin April 1.

The specific aim of this investigation, will be to determine the types of biological organisms which contribute to stabilization in anaerobic-aerobic lagoon systems at high loadings, and to relate them to the physical and chemical changes which occur in the stabilization process. Algae, bacteria, protozoa, and other organisms which predominate in anaerobic and aerobic pond systems will be investigated, and factors contributing to their survivals and efficiencies will be evaluated. Primary emphasis will be placed on algae species, factors leading to their lack of growth in anaerobic systems, and successive stages of their development and growth as the systems become aerobic in successive ponds. Attempts will be made to determine the limiting factors for algae growth in anaerobic and aerobic lagoons. Related items which will be studied include conditions under which anaerobic ponds can be operated without odors, organisms which grow in the bottom sludge in anaerobic lagoons, and the effect of the aerobic environment of the second pond on anaerobic organisms developed in the anerobic state. This requires extensive biological studies and control tests.

Space has been allocated for the project at the Pullman sewage treatment plant and the cooperation and assistance of city officials has been assured. Prof. Dunstan disclosed that a laboratory is available at the plant for routine analyses, but most chemical and all microbiological analyses will be made at the sanitary engineering laboratory. Pilot studies will also be conducted at the sanitary engineering laboratory to supplement and further amplify results obtained in the pond tests. Attempts will be made to determine the disposition of algae as waste degradation causes depletion of oxygen at the same rate, more slowly than, and faster than it can be produced by algae. It is further hoped that this study will provide additional information on the role of algae in waste stabilization by lagooning. It should also be possible to produce in anaerobic-aerobic pond systems the contributing factors which cause algae to grow in the transition zone between anaerobic and aerobic environments and to become, finally, the important source of oxygen supply which they are in the aerobic ponds.

The research program will be spread over a period of three years, as provided in the proposal. The first year will be spent in the identification of algae which predominate in the systems under specific oxygen tensions, and correlation of results with environmental conditions. This study will be continued during the second year. In addition, bottom dwelling organisms, and others known to be anaerobic in the anaerobic ponds, will be investigated to observe their disposition in the aerobic ponds and to determine the effects of the aerobic environment on their degradation efficiencies. In the second and third years, the laboratory pilot plant will be used in conjunction with field ponds to investigate the specific factors causing algae inhibition in anaerobic, and at times, in aerobic ponds.

Commenting on the study, Prof. Dunstan remarked, "The anaerobic-aerobic type of pond has seldom been used in this country and, consequently, there is a need for basic data on this combination. Although this investigation is fundamentally basic in nature, results of this study should also contribute information necessary to establish a basis for designing ponds of minimum size for particular loadings, thereby improving the economics of lagoon treatment."



Prof. G. H. Dunstan, and Dr. Rolf T. Skrinde inspect experimental ponds which will be used in their study of anaerobic-aerobic sewage ponds.

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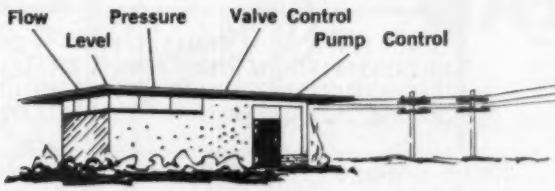

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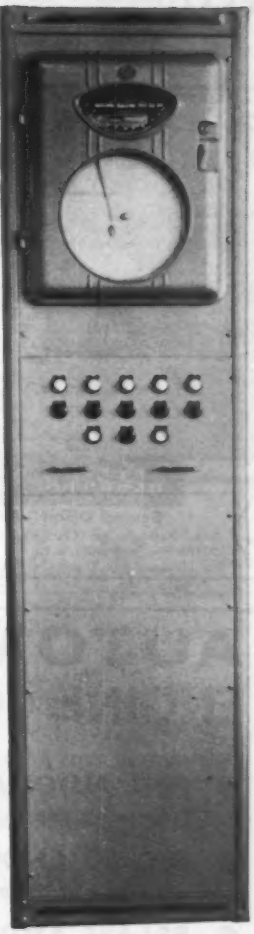

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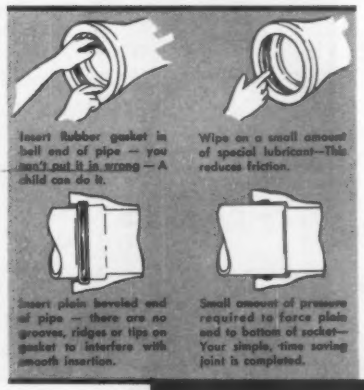
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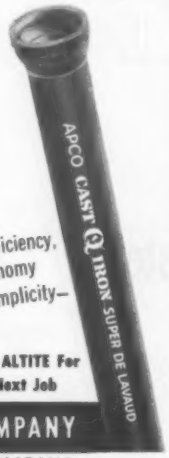
Small amount of pressure required to force plain end to bottom of socket—Your simple, time saving joint is completed.



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Apr. 3-8— New York City, N. Y. (*Coliseum*) 6TH NUCLEAR CONGRESS sponsored by EJC and other engineering and scientific societies including A.W.W.A.

Apr. 5-7—Binghamton, N. Y. (*Sheraton-Binghamton Hotel*) NEW YORK SECTION, A.W.W.A., Secy: Kimball Blanchard, N. Y. Branch Sales Off., Neptune Meter Co., 2222 Jackson Ave., Long Island City.

Apr. 5-14—Cleveland, O. (*Hotel Netherland-Hilton*) NATIONAL MEETING—AMER. CHEM. SOCIETY DIV. OF WATER & SAN. CHEMISTRY Symposium on Indust. Wastes in conjunctn. with 137th Meeting., Prof. C. Fred Gurnham Head of Dept. of Chem. Engrg., Michigan State Univ., E. Lansing.

Apr. 6—Columbia, Missouri. (*Univ. of Missouri*) MISSOURI SECTION A.W.W.A. and Univ. of Missouri, Joint Confer. on Water Softening and Stabilization of Softened Water.

Apr. 7-8—Raleigh, N. C. (*State College Campus*) 9TH ANNUAL MUNICIPAL & INDUST. WASTE CONFER. Write: The Div. of College Extn., P. O. Box 5125 State College Sta., Raleigh, N. C.

Apr. 20-22—New York, N. Y. (*Manhattan College*) THIRD BIOLOGICAL WASTE TREATMENT CONFER. Write: W. Wesley Eckenfelder, Assoc. Prof. Manhattan College, New York 71.

Apr. 20-22—Lincoln, Neb. (*Cornhusker Hotel*) NEBRASKA SECTION, A.W.W.A., Secy: J. J. Rossbach Jr., Civ. Engr. Metropolitan Utilities Dist. 3906 N. 48th St., Omaha.

Apr. 20-22—Emporia, Kan. (*Broadview Hotel*) KANSAS SECTION, A.W.W.A., Secy: H. W. Badley, Repr., Neptune Meter Co. 119 W. Cloud, Salina.

CONTINUED ON PAGE 98A

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Apr. 22-24— Emporia, Kan. (*Broadview Hotel*) KANSAS SEWAGE AND INDUSTRIAL WASTES, ASSN. Secy-treas: James F. Aiken 1900 E. 9th St., Wichita.

Apr. 24-27—Buffalo, N. Y. (*Statler Hotel*) CANADIAN SECTION A.W.W.A., Secy: A. E. Berry, 72, Grenville St., Toronto, Ont.

Apr. 27-30—Berkeley, Calif. (*Claremont Hotel*) Calif. SEWAGE AND INDUSTRIAL WASTES ASSN. Write A. D. Leipzig, Secy.-Treas., c/o Hyperion Sewage Treatment Plant, 1200 Vista Del Mar, Venice, Calif.

Apr. 28-30—Tucson, Arizona (*Pioneer Hotel*) ARIZONA SECTION, A.W.W.A., Secy: A. D. Cox Jr. Secy. & Comptroller, Arizona Water Co., Box 5347, Phoenix.

Apr. 28-30—Billings, Mont. (*Northern Hotel*) MONTANA SECTION, A.W.W.A., Secy: A. W. Clarkson, Asst. Dir., Div. of Envirn. Sanit. State Board of Health, Helena.

Apr. 28-30—Billings Mont. (*Northern Hotel*) Montana SEWAGE & INDUST. WASTES ASSN. Secy-Treas: A. W. Clarkson, Div. of Envirn. Sanit., State Brd. of Health, Helena

May 3-5—Lafayette, Indiana. (*Purdue Memorial Union Bldg.*) 15th PURDUE INDUSTRIAL WASTES CONFER.

May 4-6—Portland, Ore. (*Benson Hotel*) PACIFIC NORTHWEST SECTION, A.W.W.A., Secy: F. D. Jones, W. 2108 Maxwell Ave., Spokane 11, Wash.

May 6—Harrisburg, Pa. (*Penn-Harris Hotel*) EIGHTH ANNUAL PENNSYLVANIA CLEAN STREAMS Confer, sponsored by Pollution Abatement Comm. Pennsylvania State Chamber of Commerce. Secy: R. V. Wall, State Chamber of Commerce

May 15-20—Miami Beach, Fla. (*Bal Harbour Hotel*). A.W.W.A. CONVENTION

Jun. 1-3—Morgantown, West Va. (*West Va. Univ.*) Fifth Annual Appalachian Underground Corrosion Short Course. Write: Mr. John H. Alm, Room 605, 2 Gateway Center, Pittsburgh 22, Pa.

Jun. 12-17—Madison, Wis. (*Lorraine Hotel*) CENTRAL STATES SEWAGE & INDUST. WASTES ASSN., Secy-Treas: Scott A. Linsley P. O. Box 3598, Childs Rd., St. Paul, Minn.

June 14-17—Pittsburgh, Pa. (*Hilton Hotel*) PENNSYLVANIA SECTION, A.W.W.A., Secy: L. S. Morgan, 413 First National Bank Bldg., Greensburg.

Jun. 19-22—Mexico City, Mexico (*Del Prado Hotel*) MEETING OF AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

Jun. 20-24—Scarborough, England INSTITUTE OF SEWAGE PURIFICATION, England Secy: W. F. A. Snook, 10 Cromwell Pl.,So. Kensington, London, S. W. 7, England

July 24-Aug. 5—Columbia University (*Arden House*) Harriman Campus. NINTH ANNUAL UTILITY MANAGEMENT WORKSHOP

Aug. 23-25—Cincinnati, Ohio. (*Sanitary Engineering Center*) Public Health Service Symposium on Water Quality Data Collection and Utilization. Director, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, Ohio

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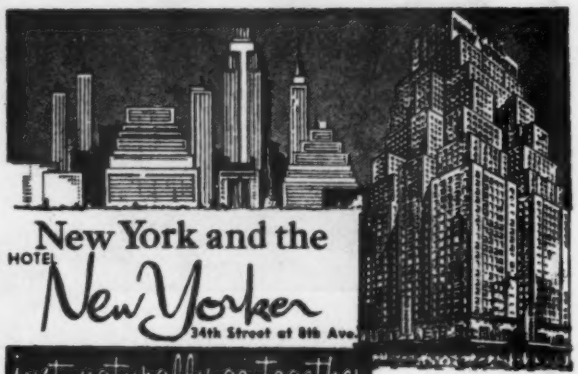

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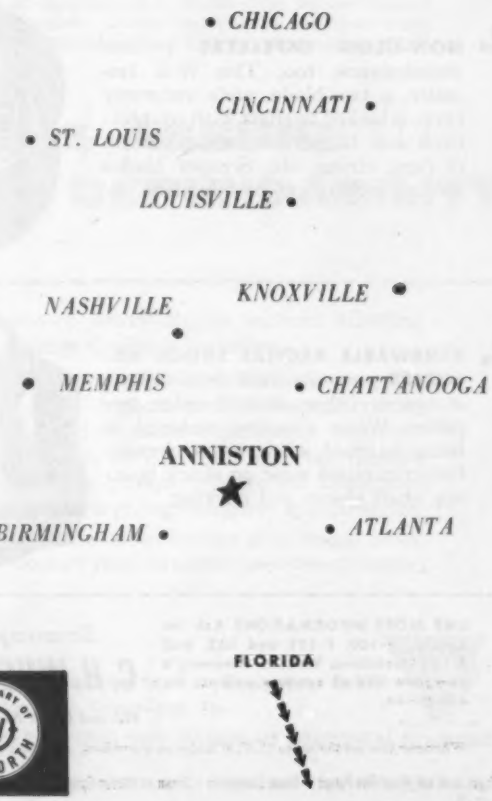

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SUBSIDIARY OF WALWORTH

News of Suppliers

CONTINUED FROM PAGE 29A

tion's program of product diversification and the expansion of its operations.

Mr. Pollock was previously employed at the Oak Ridge Institute of Nuclear Studies, Oak Ridge, Tennessee, where he established a training program dealing with the uses of radioisotopes in industry and process control. Previously, he was Director of Technical Services and Chief Engineer for the Victoreen Instrument Company, Cleveland, and a Vice-President of El-Tronics, Inc., Philadelphia.

Ionics to Build New Plant

Ionics, Inc., Cambridge, Mass., announces that new headquarters offices and manufacturing and research facilities will be constructed on a 7¾ acre site in Waltham, Mass. Preliminary land development to accommodate an 80,000 square foot building is expected to begin this spring, and plant construction is scheduled to start in late 1960.

The new plant will be located on top of a knoll in a scenic location on the eastern shore of Stony Brook Reservoir about 1,000 feet from Route 128. It will be within the Waltham commercial zone, about two miles from Waltham Center, and about one mile north of the traffic interchange at the junction of Routes 128 and 30 and the Massachusetts Turnpike.

C. H. Wheeler Announces Acquisitions

C. H. Wheeler Mfg. Co., Philadelphia, Pa., recently announced the acquisition by its parent company, Hamilton-Thomas corporation of Hamilton, Ohio, of major interests in Griscom-Russell Co., Massillon, Ohio, and Smart-Turner Machine Company, Ltd., Hamilton, Ontario, Canada.

Griscom-Russell specializes in making heat exchangers, including liquid metal heat exchangers for atomic power plants.

The company's new Canadian affiliate, Smart-Turner Machine Company, Ltd., manufactures a line of pumps which will be supplemented by Wheeler in the field. In addition, Smart-Turner will be closely associated with the Klipfel Valve Division of Hamilton-Thomas and will produce automatic regulating valves built to Klipfel specifications.

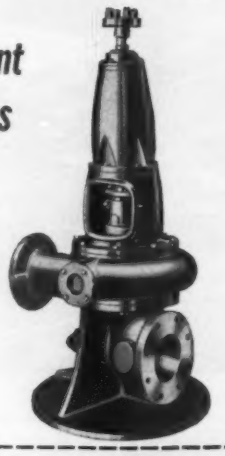
Slajchert Receives Eimco Appointment

Process Engineers, Inc., Division of Eimco Corporation, San Mateo, Calif., have announced the appointment of George Slajchert as West Coast Manager of Industrial Sales. He will be responsible for sales activities for Eimco filtration, agitation, sedimentation and industrial waste and water treatment equipment.

A graduate of the University of Nebraska, Mr. Slajchert joined Eimco in 1952 after serving with the States of Nebraska and California where he was engaged primarily in sanitary work.

What to look for when you want low-maintenance sewage pumps

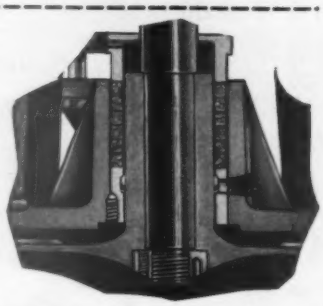
Wheeler-Economy, with half a century experience in the field, finds these are important features:



1. CLEAR, UNOBSTRUCTED, CAREFULLY DESIGNED WATERWAYS allow your pumps to pass exceptionally large rags, sticks, stones and solids without clogging. This 12" x 10" Wheeler-Economy Non-Clog Pump, for example, handles 7" solids easily.

2. NON-CLOG IMPELLERS reduce maintenance, too. This W-E Impeller, a two-blade, wide-waterway type, is locked to shaft with countersunk nut to prevent accumulation of rags, string, etc. Scraper blades are on back to prevent binding.

3. RENEWABLE BRONZE SHOCK ABSORBER prevents shaft deflection as stones or other objects enter impeller. When abrasive material is being handled, clear water connection minimizes wear on shock bearing, shaft sleeve and packing.



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Economy Pump Division

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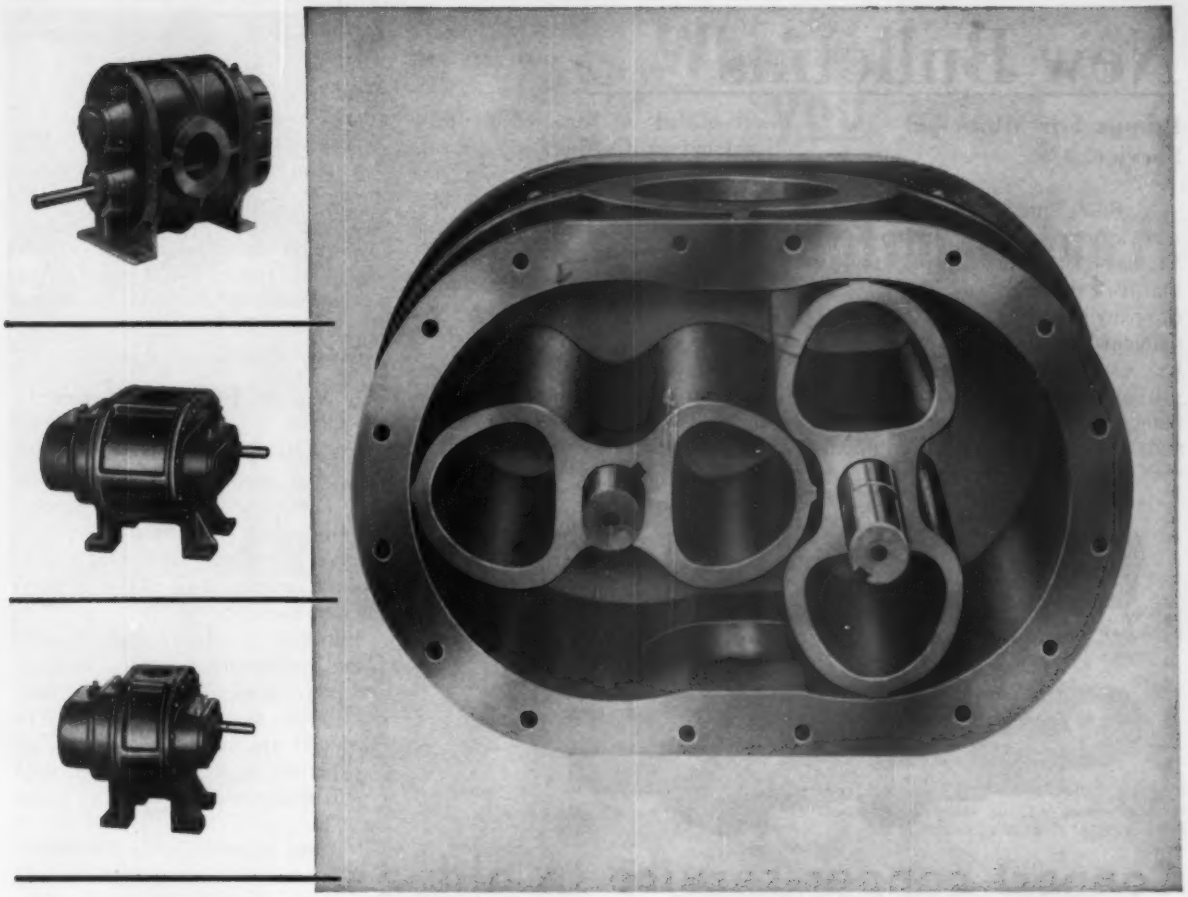

Sutorbilt blowers deliver air or gas at capacities up to 20,000 cubic feet per minute and pressures or vacuums up to 10 pounds. Design incorporates two figure-eight impellers which rotate in opposite direction and deliver a metered volume of air or gas.

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These and other Sutorbilt design features —plus highest-quality manufacturing methods—assure maximum, maintenance-free service from Sutorbilt blowers and gas pumps. Write for illustrated brochure giving complete specifications.

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New Bulletins

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Pumps For Municipal Service

408

Marlow Pumps, Division of Bell and Gossett Company, Morton Grove, Ill., has released their 16-page bulletin that lists, describes and illustrates the company's line of pumps designed for municipal and industrial wastes service.

Three types of units are covered: plunger pumps, diaphragm pumps, and self-priming centrifugal pumps. Each of these is explained by operational and construction data, and each is shown in typical on-the-job applications. Besides these pictures, tables, graphs and cutaway drawings provide additional pertinent information.

High Horsepower Single-Phase Motors

409

System Analyzer Corp., Nokomis, Ill., has issued a 4-page bulletin that describes their Power Twin-Universal electric motors that are able to achieve from 7½ to 60 horsepower using single phase current.

These units are designed to reduce inrush currents to approximately 50% less than standard single phase motors. They may be used with either 220 or 440 volt service.

General data, an inrush currents chart, and typical performance curves are included in the bulletin, as well as a description of the motor, its operation and construction features.

Air Valves For Pipe Lines

410

Multiplex Manufacturing Co., Berwick, Pa., is offering its recently published 28-page catalog that gives a comprehensive presentation of their Crispin line of air valves used to control the amount of air in liquid carrying pipe lines.

Filtration plants, sewage disposal plants, reservoirs, pumping stations, and power plants are among the various services that use this product. The particular application of these valves is explained in the catalog, and each type is illustrated by a cutaway drawing.

Further information on the operation, construction and performance of the valves is provided by charts, tables and graphs. Dimensional data are also included.

Gear Motors and Reducers

411

Sterling Electric Motors, Inc., Los Angeles, Calif., are offering a new 8-page bulletin pertaining to their line of Slo-Speed Gear Motors and Slo-Speed Separate Motor Reducers.

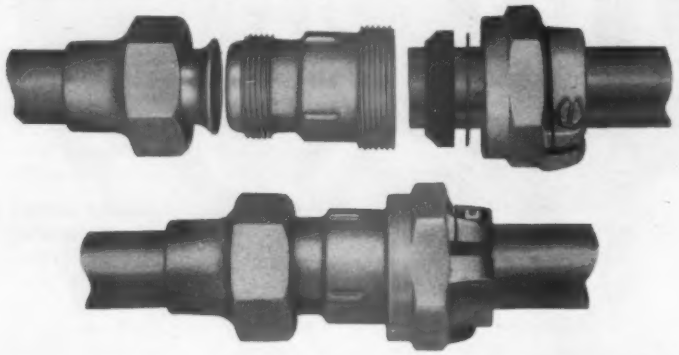
The bulletin, No. 198, describes and illustrates the features of the Slo-Speed design, the basic types and many modifications, as well as the universal mounting positions in which these units may be used.

Standby Electric Plants

412

D. W. Onan & Sons Inc., Minneapolis, Minn., are offering an 8-page folder entitled, "Standby Electric Plants and Controls—a Guide to their Selection and Installation." For those who have a need for emergency electric power, this bulletin is the official Onan insert in the 1960 Sweet's Architectural File. It is available to all consulting, design and electrical engineers; architects; federal, state,

CONTINUED ON PAGE 104A



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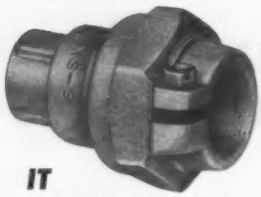

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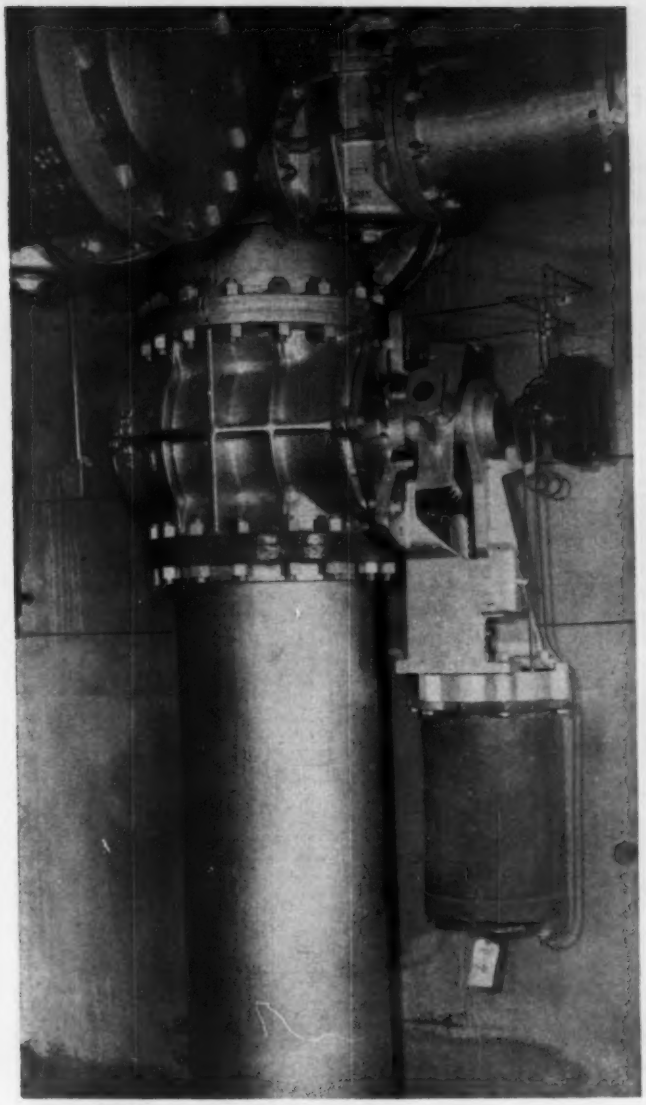

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The cylinder operator on DeZurik Filter Control Valves is mounted parallel to the pipe—it does not project out at right angles to interfere with other piping.

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New Bulletins

CONTINUED FROM PAGE 102A

county and city officials; and public utilities personnel.

Beginning with the need for standby power, Onan's new folder outlines clearly the steps to be considered in the selection of any emergency electric generating plant. Practical suggestions are offered in the planning and designing of the installation; the degree of protection desired; important "musts" to consider; and common errors to avoid.

The folder lists items to evaluate to meet particular requirements in specific installations—for example: Manual, automatic or instantaneous starting; type of fuel; air or water-cooling; special heaters; radio shielding; plant exercisers and instrument panels.

Controlled Motor Speed Systems

413

U. S. Electrical Motors, Inc., Los Angeles and Milford, Conn., has just released a new 8-page brochure, describing the U. S. Varidyne, A.C., controlled speed systems.

The brochure, amply illustrated with schematic and realistic drawings as well as application photographs, explains briefly the U. S. Varidyne controlled speed system principle. It shows how Varidyne uses alternating current characteristics to provide adjustable speeds by converting fixed-speed A.C. motors to adjustable speeds on either existing equipment or original equipment, regardless of whether one motor or many motors are involved.

The bulletin further explains how Varidyne provides inherent speed coordination in multi-motor installations, and in such applications, automatically distributes loads equally.

Vibratory Feeder Catalog

414

Syntron Company, Homer City, Pa., has announced the publication of a 32-page catalog on Syntron vibratory Feeders.

Complete descriptions, data and specifications, along with more than

CONTINUED ON PAGE 106A

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Only a third of the Jeffrey flocculation-settling system is visible in this construction photograph.

Taken two years ago, this airview shows the wide extent of this 122 mgd treatment plant. Consulting Engineers, Haven & Emerson of Cleveland and New York.

Flocculation and settling are handled here in the same tanks, training baffles being used to separate the two functions. Eight of these combination tanks provide detention in the flocculation zone for 30 minutes and in the settling zone for 90 minutes, or a total of 120 minutes of settling time without flocculation, based on a daily flow of 122 mgd.

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New Bulletins

CONTINUED FROM PAGE 104A

Enzyme Powders For Small Flood Control

415

Suburban Products Co., Philadelphia, Pa., has published a new bulletin on enzyme powders that explains how these powders may be used safely to overcome flooding in commercial and residential sewage systems resulting from melting snows and heavy rains.

The powdered enzymes break down proteins, fats and starches, that are forced through cracks in manholes and septic tank walls in large quantities of undigested materials that travel into drainfields, and help to keep ground drainage at a peak.

Automatic Material-Level Indicator

416

Fuller Co., Catasauqua, Pa., is offering a bulletin describing how material-level indicators may accurately and automatically control the level of pulverized, fine, crushed or granular material in a storage bin. The general purpose model (SG-4) and a specially-designed model for hazardous dust conditions (SG-4X) are discussed.

The difference between the two models is explained and the operation of their component parts is given a detailed account. Since either model can be used as a high or low level control, a description of performance at both levels is included. Current requirements, control switches and a safety pulse switch, which indicates that the entire mechanism is in working order, are also discussed. A wiring diagram illustrates the operation of the switches.

The bulletin contains a full-page schematic drawing of a material-level indicator, a photograph of a typical installation of a vertical-mounted indicator and a drawing giving five examples of application.

Dry Materials Feeder

417

Vibra Screw Feeders, Inc., Clifton, N.J., has made available literature that describes and illustrates its Gravimetric dry materials feeding machinery. The literature not only presents a dia-

CONTINUED FROM PAGE 104

[illegible]0 illustrations, for the company's line of small, heavy and extra-heavy-duty standard electromagnetically vibrated Feeders are presented.

Spreader Feeders, "heat-resistant" Furnace Feeders, Drying, Preheating and Cooling Feeders, Picking Tables, Conveyors, and Elevator Feeders are also featured. In addition, data is included on three pneumatically and hydraulically vibrated Feeders for explosive materials, dangerous atmospheres or for light, fluffy materials.

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gram and performance table but also gives a detailed explanation of the equipment's major components and principle operational data.

Automatic Bulk Weighing Scale

418

Richardson Scale Company, Clifton, N. J., has released its recently published bulletin that describes their model E-50 bulk weighing scale. This machinery is designed specifically for process weighing and is completely automatic in operation.

The equipment and its components are pictured in the bulletin, and both cutaway drawings and diagrams illustrate the operation of the scale. A list of the standard specifications, a list of the optional features, and a list of the product's applications are also included.

Sewage Sludge Concentrator

419

Nichols Engineering and Research Corp., New York, N.Y., has just published their technical bulletin RP 100 that describes the new Roto-Plug sewage concentrator designed for municipal and industrial wastes application.

The purpose of the concentrator is to permit sewage and industrial sludge to be thickened and dewatered without the use of chemicals, and without requiring the services of a technically trained operator.

A full-page cutaway drawing illustrates the operational features of the unit, and pictures show the unit in operation. General specifications and dimensional data are also included.

Comprehensive Technical Bulletin on Vacuum Filter Plants

420

B-I-F Industries of Providence, R. I., is offering, "Engineering Information on Vacuum Filter Plants," a 14-page catalog of filter plant theory, installation, operation and maintenance. This information is designed to be helpful to owners and operators of swimming pools as well as engineers responsible for municipal or industrial water plants.

A brief history of the development of vacuum diatomite filters is followed by filtration rate requirements, layout and piping suggestions, recom-

CONTINUED ON PAGE 108A

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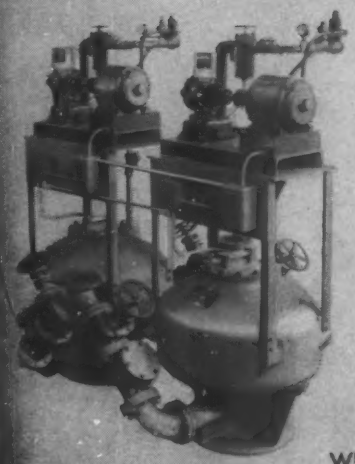

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New Bulletins

CONTINUED FROM PAGE 107A

mendations on introduction of make-up water, proper pH control and the adaptability of all-plastic filters to t water pools.

Another section is devoted to description of gravity-vacuum filters of cylindrical and rectangular design. Installation diagrams, dimensional data and rate charts are shown for each type. An accessory equipment section discusses recirculating pumps, pool heaters, hypochlorite feeders, chlorine gas feeders, soda ash feeders, chemical solution tanks, slurry feeders, and other useful items.

The operating and maintenance instructions include information on chemical cleaning, filter repairs and seasonal shutdowns.

Gauges And Instruments for Plants And Processes

421

United States Gauge Division, American Machine & Metals, Inc., Sellersville, Pa., has issued a new, 4-page bulletin entitled "Gauges And Instruments For The Process Industries". This bulletin, No. 3015, provides a quick resume of the company's products, to simplify the engineer's job of choosing the right gauge or instrument.

Featured in the bulletin are USG's pressure and vacuum gauges (USG Super-gauge and Solfrunt series), indicating pneumatic controllers, and pneumatic transmitters. A schematic drawing shows the installation of a USG indicating pneumatic controller in a typical "cascade" control system. This device has found wide application in sensing and indicating pressure or temperature.

The bulletin also includes construction details and technical data. Photographs illustrate range and linearity adjustment and pointer adjustments.

Tables list tube forms and materials, socket and tip materials, pressure ratings, flange types and Figure Nos. for ordering purposes.

Other USG instruments are also described, including: general "utility" gauges, test gauges, dial thermometers, pneumatic receivers, recorders and recorder controllers, drawn steel case gauges, pressure or temperature alarms and receivers.

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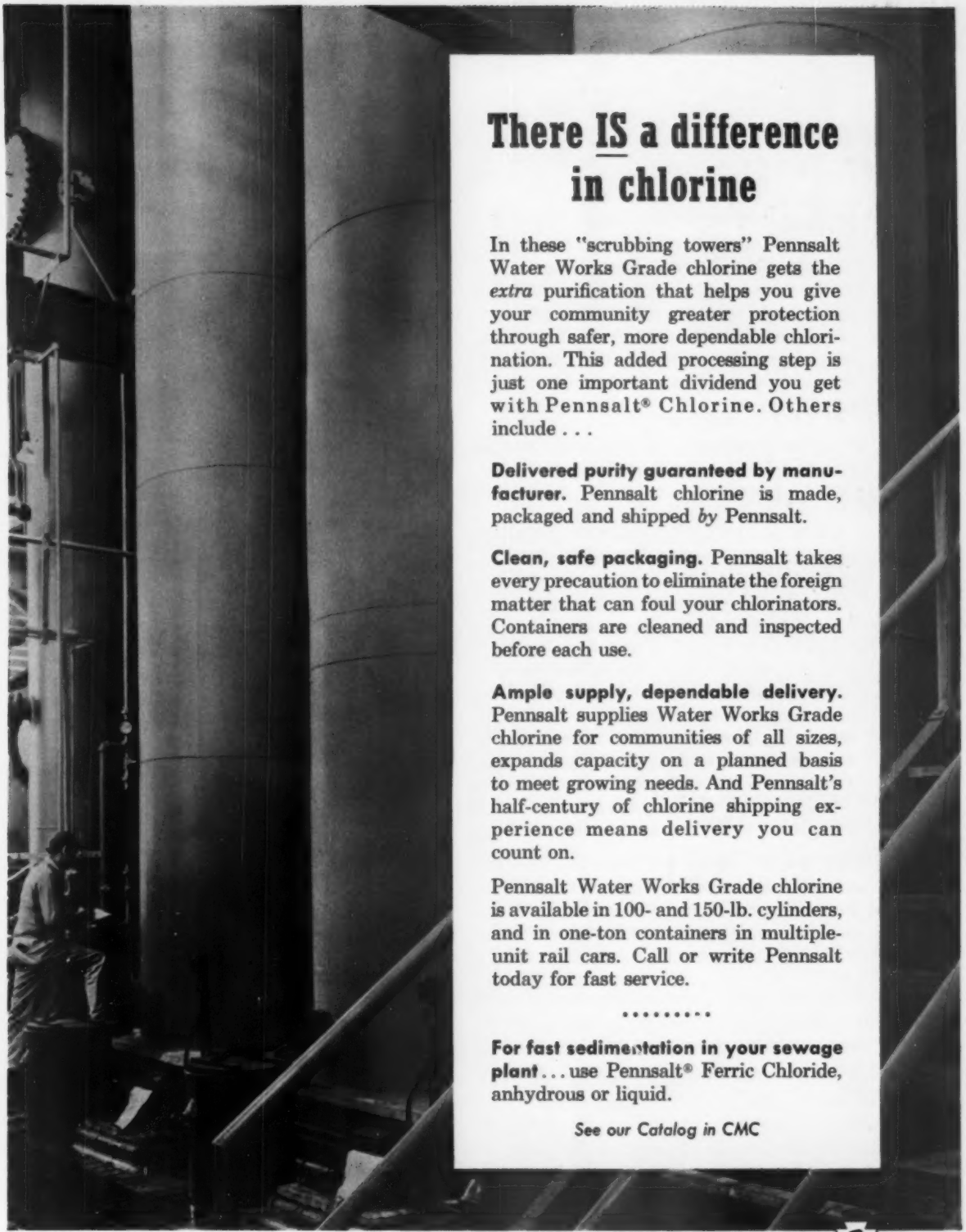

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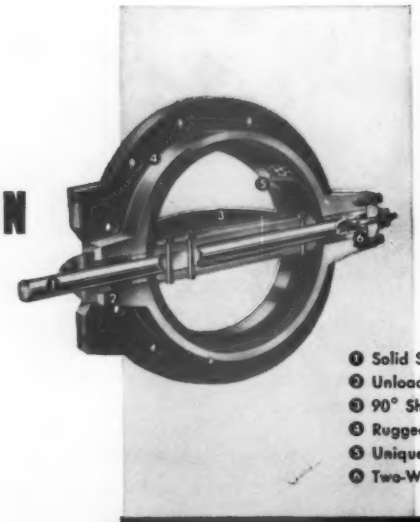

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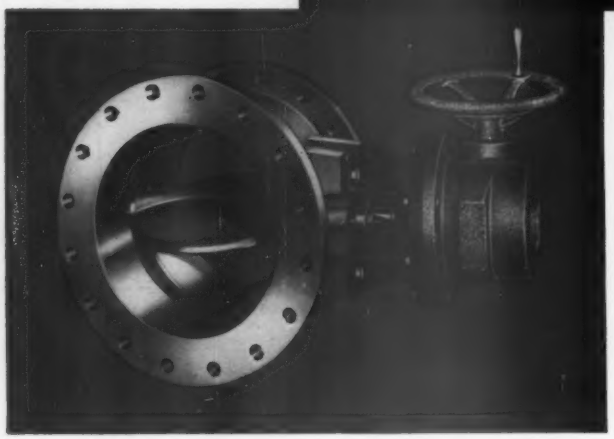

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